SCIENCE ABSTRACTS.

Section A.—PHYSICS.

NOVEMBER 1905.

GENERAL PHYSICS.

2016. *Elasticity Constants of Rock Salt and Artificial Chrome Alum.* **S. Maresca.** (N. Cimento, 10. pp. 18–29, July, 1905.)—The modulus of elasticity, S_{mn}, and elasticity constant, C_{mn}, of a body crystallising in the regular system, are connected by the relations $C_{11} = (S_{11} + S_{12})/(S_{11} - S_{12})(S_{11} + S_{12})$, $C_{12} = -S_{12}/(S_{11} - S_{12})(S_{11} + 2S_{12})$, and $C_{44} = 1/S_{44}$, and the coefficients of flexure and torsion can also be expressed in terms of the elasticity modulus; hence by determining these coefficients for a body, its elasticity constant can be deduced. Applying this method to rock salt and artificial chrome alum, the author obtains for the former $C_{11} = 4{,}753{,}000$, $C_{12} = 1{,}271{,}000$, and $C_{44} = 1{,}313{,}000$, and for the latter $C_{11} = 1{,}606{,}000$, $C_{12} = 450{,}000$, and $C_{44} = 750{,}000$. Poisson's relation is verified for rock salt, but not for chrome alum, and the coefficients of cubical dilation found are $41{\cdot}07 \times 10^{-8}$ and $119{\cdot}67 \times 10^{-8}$ respectively. W. H. Si.

2017. *Permanent Deformation of Metals.* **G. H. Gulliver.** (Inst. Mech. Engin., Proc. 1. pp. 141–147, Jan.-Feb., 1905.)—From the results of his experiments the author argues that Lüders' lines and the "contractile cross" are different phenomena. In flat bars the former (here confused with slip-bands) appeared at the yield inclined at 50° to the axis of the bar. Upon straining to rupture they gradually turned until inclined at 45°, in the same way as a line scribed on the bar would do. The arms of the contractile cross, however, along one of which rupture frequently occurs, were inclined at 65° to the axis. Other experimental results are described which support this view. F. R.

2018. *Effect of Combined Stresses on Elastic Properties of Steel.* **E. L. Hancock.** (Eng. News, 54. pp. 209–210, Aug. 24, 1905. Paper read before the Amer. Soc. for Testing Materials, June, 1905.)—Tensile stresses were applied in an ordinary testing machine, the ½-in. diam. specimens being held in ball-bearing torsion heads, through which a couple could be applied by long arms. A 3 per cent. nickel steel, with tensile elastic limit at 56,000 lbs. per sq. in., was found, when tested under torsional stress ⅓, ⅔, and the whole of its torsional elastic range, to have its tensile elastic limit lowered 7, 21, and

63 per cent. respectively; and Young's modulus was also lowered by a roughly constant amount by torsion. In the case of a 0·24 per cent. carbon steel of 34,000 lbs. per sq. in. tensile elastic limit, the elastic limits were lowered, under corresponding torsional conditions, by 6, 30, and 54 per cent.; the Young's modulus remained the same in the former of these three tests, but was lower in the other two. There was an increase of torsional strain during increase of tension in all cases. A piece of the nickel steel tested in torsion, with and without 4,000 lbs. per sq. in. tension, gave a lower elastic limit whilst under tension, and apparently a higher torsional modulus. F. R.

2019. *Influence of Phase Change on Tenacity of Metals at Ordinary and Liquid-air Temperatures.* **G. T. Beilby** and **N. H. Beilby.** (Roy. Soc., Proc. Ser. A. 76. pp. 462–468, Sept. 13, 1905.)—The subject is treated from the standpoint of the theory of a phase change accompanying mechanical deformation, as set forth by the authors in an earlier paper [see Abstract No. 2506B (1904)]. With the object of advancing the general knowledge of molecular cohesion, the authors wished to determine the maximum tenacity which can be reached in the metals investigated, and for this purpose wished to transform the metal as completely as possible into the "amorphous phase"; they accordingly determined the maximum tenacity which could be attained by wire-drawing the metals, the tenacity and extension being measured both at the ordinary and at liquid-air temperatures. An interesting observation made by the authors is that a wire so hardened as to break without further stretching at the ordinary temperature, showed an extension before fracture of about 11 per cent. when tested at the boiling-point of liquid air. For the theoretical discussion of the experiments, and the photomicrographs with which it is illustrated, the reader must be referred to the original paper. W. Ros.

2020. *Laws of Distribution of Size in Raindrops.* **A. Defant.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 585–646, May, 1905. From the Inst. f. kosmische Physik an der k.k. Univ. in Innsbruck.)—The method adopted for reckoning the sizes of raindrops, viz., Wiesner's, consists in receiving the drops on filter-paper and allowing them to spread. They are then considered as flat cylinders, of which the weight can be determined. In the first section of the paper the relation between the weight of a drop and the radius of the spot made by it on filter-paper is found by means of artificial drops. One leg of a siphon tube is immersed in a long glass vessel of water, and the end of the other leg is fitted with end-pieces of different bore, the end-pieces being tipped with paraffin wax to ensure a quick and regular fall of drops even of the smallest size (0·63 mgm., 1·12 mm. diam.). A number of drops is collected and weighed; an equal number is absorbed on filter-paper and measured, and the relation between weight and radius of spot is expressed by: Weight $= \pi r^2(0{\cdot}0306 + 0{\cdot}00283r - 0{\cdot}0000402r^2)$. The paper used was a baryta filter-paper made by Dreverhoff, of Dresden, which gave homogeneous and regular results. The size of the spot is not perceptibly influenced either by the hygrometric state of the air or by the use of a dye composed of a mixture of eosin and talc powder, for fixing the spots. In the application of the method to actual raindrops, over 10,000 drops were measured from 38 rainfalls, an average of 7 sheets of paper being exposed for 1 sec. in each rainfall. The exposures were generally made from a window, the paper being stretched on a frame and covered on one side. During all rainfalls certain sizes of drops are found to occur more frequently than others, and for these it holds that the weight of the larger drops is a multiple of the weight of the smaller ones, the most frequent sizes being in the ratios 1 : 2 : 3 : 4 : 6 : 8 : 12 : 16, &c., and among these the chief maxima are as 1 : 2 : 4 : 8. This law of distribution holds for all kinds of rain, and the same size of drop occurs with maximum frequency both in quiet rainfalls and thunder showers, the frequency maxima being for drops of weight 0·11, 0·23, 0·35, 0·46, 0·69, 0·92, 1·38, 1·84, 2·76, and 3·68 mgm. There is a tendency for drops of equal size to coalesce in more cases than unequal-sized drops. As a consequence and verification of this, the sixfold drop occurs oftener than the threefold. [See also Abstract No. 517 (1905).] G. E. A.

2021. *Variations in Atmospheric Transparency during* 1902, 1903, *and* 1904. **H. H. Kimball.** (Monthly Weather Rev. 33. pp. 100–101, March, 1905.)—Comparisons of series of measures of solar radiation and polarisation of blue sky light made by the author and E. Marchand show interesting coincidences. A distinct diminution in the amount of solar radiation received at the earth's surface was noted at intervals after May 27, 1902, which became permanent in Jan., 1903, at which it amounted to about 20 per cent. of the normal radiation. On the 21st and 22nd of Feb., 1903, it attained the value of 50 per cent., and continued to be quite marked until Aug., 1903, after which it gradually became less, although it was quite noticeable at times up to the end of 1904. The blueness of the sky suffered a diminution of 3 units, measured on a scale of 0–50. Observations at the Astrophysical Observatory of the Smithsonian Institution indicate that during 1903–4 the actual amount of radiation received at the outer surface of the earth's atmosphere was less than the normal. The variations cited above are ascribed to the influence of the fine dust ejected from the West Indian volcanoes in May, 1902. C. P. B.

2022. *Rate of Transmission of the Guatemala Earthquake.* **R. D. Oldham.** (Roy. Soc., Proc. Ser. A. 76. pp. 102–111, May 24, 1905.)—In 1900 the author showed that three forms of wave motion could be recognised in earthquake records, travelling on different paths at different speeds. The first and the second phase seemed to be mass waves travelling through the earth, the third a gravitational and elastic wave, travelling near the surface. These views were confirmed by Milne; but Japanese observers distinguish eight phases, $P_1 \ldots P_8$, of which P_1 and P_2 correspond to Oldham's first and second phases, and the rest to the third. The author finds that these distinctions are based on the records of 85 earthquakes, of which 31 were not observed outside Japan, while in the remaining 54 cases time and origin were not well known except in five cases. One of the latter is the Guatemala earthquake of April 19, 1902, with which Imamura has especially dealt. The author tabulates all the 61 records of this earthquake, which started at 8.20 p.m., local time (not 8.25, Imamura). The first phase seems to have been transmitted at a rate continuously increasing with the distance; at places from 140 to 160° from the origin the wave appears to have emerged simultaneously. The second phase also travelled at an increasing rate, but only up to a distance of 100° from the origin; then the rate decreased. This is an unexpected result; the records of the second phase were not well marked, however. The third phase seems to have travelled at a practically uniform rate. The record from Kodaikanal (an observatory station) was discordant. H. B.

2023. *Temperature Inversions on Ben Nevis.* **A. Watt.** (Nature, 71. pp. 583–584, April 20, 1905.)—Referring to the letters by Dines and by Rotch [see Abstract No. 684 (1905)], and distinguishing class I., inversion when Ben Nevis was warmer than Fort William at one hour of the day; II., throughout each of the 24 hours; III., on the mean of the 24 hours, the author states that in the thirteen years, 1891–1903, inversions were observed: I. in 158, II. 9, III. 33 cases. The inversions occurred in all seasons, II. only in Feb., Nov., Dec., however, and III. only between Sept. and March. The average difference of temperature between Ben Nevis (4,700 ft.) and Fort William ranged from 16·8° F. in April to 14·4° in Dec.; the mean for the year is 15·4°. The greatest inversion was recorded during the great frost of 1895, on Feb. 19, at 9 a.m., Ben Nevis 33·6°, Fort William 16·0° F.; the longest continued inversion lasted 58 hours, Nov. 2–5, 1895, the difference being 9·7°. H. B.

2024. *Indian Earthquake of April* 4, 1905. **C. F. Marvin.** (Monthly Weather Rev. 33. pp. 148–149, April, 1905.)—The great earthquake which almost entirely destroyed the mountain towns of Dharmsala, Kangra, and Palampier, in North-Western India, was very fully recorded at Washington, D.C., on the Bosch-Omori seismograph at the Weather Bureau. The vibratory motion persisted for an unusually long time (2h. 30m.), but that part of the record embracing the maximum displacement only was relatively of short duration. A reproduction of this part of the curve is given with the paper. Taking the probable time of occurrence at Dharmsala as 6h. 02m. a.m., the record arrived at Washington at 6h. 21m. a.m., so that the wave occupied 19 min. in transmission. If propagated along the chord joining the two stations, 6,264 miles apart, the velocity would be 5·5 miles (8·9 km.) per sec. This is 49 per cent. higher than the highest velocity observed for sound waves in the most elastic kinds of glass. If the waves were transmitted through the crust of the earth's surface along a great circle the velocity would have been 6·4 miles (10·3 km.) per sec. No actual measurements of the angle of emergence of the earthquake wave at Washington were made, but close attention to this might give some clue to the actual path of a disturbance through the earth's mass. C. P. B.

2025. *Periodical Changes in the Position of the Earth's Centre of Gravity.* **R. Spitaler.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 695–710, June, 1905.)—The writer refers to earlier works of his own (Ergänzungsheft, No. 137, Petersen's Mittheilungen, 1901) as having shown that the observed periodic annual variation of the position of the earth's axis of rotation can be approximately explained by the changes of position of the atmosphere at the different seasons. Klein and Sommerfeld, comparing this hypothesis with theory, came to the conclusion that as regards sign and order of magnitude it gave correct results. The considerable divergences may be due in part to our complete ignorance of atmospheric phenomena in high Antarctic latitudes, and in part to the fact that movements of water as well as of air may be concerned. He refers to the observations of Kimura, confirmed by Albrecht, showing a small annual oscillation, independent of the point of observation on the earth's surface, of the position of the rotation axis. This he gives in tabular form. Various explanations of this phenomenon are discussed. It is suggested that a possible cause of Kimura's phenomenon may be a general variation of the horizontal plane, due to a shifting of the earth's centre of gravity in direction of the axis, and to illustrate this a series of tables is given showing for each 10 degrees of latitude the excess of barometric pressure in January over July for different longitudes; from which also it is proposed to

calculate the position at these respective seasons, of the centre of gravity of the earth's whole atmosphere, or of the northern or southern portion of it.
S. H. B.

2026. *Rumford Spectroheliograph of Yerkes Observatory.* **P. Fox.** (Astrophys. Journ. 21. pp. 351–355, May, 1905.)—The daily routine work with the large spectroheliograph attached to the Yerkes telescope is to obtain two plates with the light of the centre of the H line (H_2), and one with the slit on the edge of the H line on the violet side (H_1). After these are taken, series of photographs are obtained with progressive settings on various lines, with the aim of recording evidence of the constitution of the solar atmosphere at different levels. During 1904 the series of H_2 plates showed a decided increase in activity over those taken in 1903, and the whole are being measured for a new determination of the solar rotation period at the height above the photosphere occupied by the high-level flocculi. The measurements are made by projecting the photographs upon an adjustable ruled globe by means of an arc lamp and suitable lenses. The analytical photographs with varying setting are giving most useful information, as five or six different images of some special feature can be obtained on the same photographic plate with light of different wave-lengths as the operative agent. It is found that these show very important differences in the appearance of the markings. With the slit set about λ3952, in the continuous spectrum about midway between H and K, the photograph shows faculæ at the limb well, and at the centre very slightly—in fact, these pictures practically resemble direct photographs of the sun, using all the light. The vague outlines of the faculæ in the centre gradually increase in distinctness as the slit approaches H until the reading is about λ3962·2, where they are very distinct and sharp. From here to λ3965·5 no change in the form of the faculæ is recorded, but from this point to λ3968·6 the change in form, size, and contrast is progressive, at first slow, then rapid. These changes are well shown in a plate giving a series of five of such photographs, including the large spot group of August 25, 1904. [See also Abstract No. 1366 (1905).] C. P. B.

2027. *Sun-spot Spectrum.* **W. M. Mitchell.** (Astrophys. Journ. 22. pp. 4–41, July, 1905.)—Working with the 23-in. refractor at the Halsted Observatory, Princeton, N.J., the author has made a complete study of the sun-spot spectrum from F–*a*, during the period March, 1904, to March, 1905. Attached to the large refractor of 30 ft. focal length was a grating spectroscope having collimator and telescope each 2½ in. diam. and 30 in. focus. The Rowland grating had a ruled surface 4 × 2½ in., with 20,000 lines to the inch, and the third order was used in most cases. In observing, the whole region was first generally surveyed for anything specially noticeable, and then a portion selected for minute examination in detail. The resolution of the spot band into numerous fine lines was well seen, chiefly in the region from the *b*'s to λ5100. The special selective action on the Fraunhofer lines is summarised into six types ; *e.g.*, lines may be widened, reversed, weakened, winged, darkened, or thinned. Of these the widened lines are the more numerous. All the observations are brought together in a table giving details of 680 lines, showing the normal intensity, spot intensity, origin, and comparison observations made by other workers. In the order of number of lines affected the elements concerned are grouped as Fe (210), unknown element (136), Ti (121), Cr (79), Ni (47), Va (43), Ca (24), Mn (20), Co (11), Na (6), Si (5). A detailed discussion is then given of the behaviour of each element in spots of various types, with the relative importance of such lines in the chromosphere spectrum. The general evidence appears to favour the idea that the spots usually occur in a stratum at a lower level than the chromosphere. [See also Abstract No. 2162 (1904).] C. P. B.

2028. *Probable New Star, R S Ophiuchi.* **E. C. Pickering.** (Astrophys. Journ. 22. pp. 90–92, July, 1905. Harvard Coll. Observatory Circ. No. 99.)—This star was first seen to be of the third type on July 15, 1898, and had the hydrogen lines Hξ, Hζ, Hδ, Hγ, and Hβ bright; also two lines which appear to coincide with the bright bands at λ4656 and λ4691 in the spectrum of γ Velorum. This spectrum greatly resembles that of Nova Sagitarii and of Nova Geminorum. A photograph taken on Aug. 28, 1894, shows that at that time the spectrum was of class K, with no evidence of bright lines. From an examination of the light curve it was found that a remarkable increase of its light occurred in 1898, from magnitude 10·70 in April to 7·69 in June; gradually decreasing again to 10·81 in the following October. It should therefore be regarded as a new star, and should be designated Nova Ophiuchi No. 3, the new stars of 1604 and 1848 having also appeared in the same constellation. C. P. B.

2029. *Solar Atmosphere in Neighbourhood of Spots.* **H. Deslandres.** (Comptes Rendus, 141. pp. 377–388, Aug. 14, 1905.)—Various suggestions are presented in explanation of the appearances photographed with the spectroheliograph, with special reference to the evidence furnished concerning the difference of level of the constituent gases. In the nucleus of a spot the ray K_2 is fine and simple, or if double is divided. On the penumbra the width of K_2 and K_3 augments rapidly. Then, all round the penumbra, in the zone of faculæ, which the author designates the median zone, the two components of K_2, in general equal, are strong, and separated by the ray K_3, which is fine. Round these again is the exterior zone, characterised by an increase in width of K_3, which may be also affected by any alteration of the width of K_2. It is suggested that it is this exterior zone which gives in spectroheliograph pictures the dark images. The various layers of the chromosphere are considered to have some relation to these zones, and a closer study by this method may lead to the elucidation of the actual differences of altitude in the solar atmosphere at which the different phenomena are produced. C. P. B.

REFERENCES.

2030. *Gyrostats and Gyrostatic Action.* **A. Gray.** (Inst. Engin. and Shipbuilders, Trans. 48. 6. pp. 6–48; Discussion, 48. 8. pp. 1–17, 1904–1905.)—A summary of the general phenomena of gyrostats which leads to the problem of a large gyrostat with axis vertical on board a ship. The author has been supplied with estimates of the data necessary for calculating the gyrostatic moments applied in possible circumstances to the hull (1) of a large Atlantic liner, (2) of a torpedo-boat destroyer, and (3) of a cross-Channel steamer. The stresses are not significant. Their only importance, if they have any, must be in their rapid reversal and the consequent forced vibration of the structure. [See also Henderson, Abstract No. 1482B (1905).] W. W. H. G.

2031. *Perturbations of the Bielid Meteors.* **A. M. W. Downing.** (Roy. Soc., Proc. Ser. A. 76. pp. 266–270, July 10, 1905.)—As a result of the calculations given, the most probable date for the centre of a shower of Bielids this year is Nov. 18, 10h., G.M.T.

2032. *Equilibrium of an Aggregate of Small Bodies.* **E. Almansi.** (Accad. Sci. Torino, Atti, 40. No. 14. pp. 707–734, 1904–1905.)—The conditions of equilibrium of a system such as an aggregate of perfectly dry sand particles are discussed. The conditions (i.) that the internal pressure satisfies the same conditions as in the case of an ordinary elastic solid, and (ii.) that the angle between the normal to any element of surface and the pressure acting over it cannot exceed a certain limit are obtained from first principles, and some of the conclusions arrived at are discussed. S. G. S.

2033. *Forced Vibrations of a Material System.* **M. Radaković.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 877–893, June, 1905.)—A mathematical treatise which obtains for the vibrations of a material system under an harmonic impressed force an equation which allows of a graphical exhibition of the course of the forced vibrations throughout the first period. E. H. B.

2034. *Alliévi's Calculation of Water-hammer Shocks.* **de Sparre.** (Houille Blanche, 4. pp. 159–166, July, 1905.)—Simplified formulæ for practical use are here given, and the action of a throttle-valve is examined, the results obtained conforming to St. Henri's observations. [See Abstracts Nos. 1245 (1904) and 1710 (1905).] R. E. B.

2035. *Simple Case of Propagation of Liquid Waves in a Pipe.* **J. Boussinesq.** (Comptes Rendus, 141. pp. 234–236, July 24, 1905.)—If the weight of an elastic tube be negligible, and if it be supported only by its ends, the laws of movement of a contained liquid will be the same as in an unstretched tube [see Abstracts Nos. 1682 and 1683 (1905)], and the speed of propagation of waves within it will not depend on the degree of fixedness of its ends. R. E. B.

2036. *Mathematical Theory of the Nocturnal Cooling of the Atmosphere.* **S. T. Tamura.** (Monthly Weather Rev. 33. pp. 138–147, April, 1905.)—A history of the problem is given, and a new attempt is made to solve it with simple assumed conditions. [But the conditions are wrongly expressed mathematically so that the differential equation is wrongly integrated, the solution giving the temperature of the least deep stratum of invariable temperature in the earth as equal to that of stellar space !] R. E. B.

2037. *Seismic Records at Göttingen in* 1904. **H. Schering.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 2. pp. 181–200, 1905.)—Continuing the work of v. d. Borne [see Abstract No. 706 (1905)], the author tabulates the records of 113 earthquakes obtained with the aid of the Wiechert astatic horizontal seismograph of 1,200 kg. weight during the year 1904. An interruption occurred in October, when the pendulum had to be dismounted to make room for other apparatus ; several improvements were effected on this occasion. A supplementary table gives the periods and amplitudes of the microseismic movements of the N.-S. component ; the amplitudes of the E.-W. component were always smaller. H. B.

2038. *Variable Radial Velocity of γ Geminorum.* **V. M. Slipher.** (Astrophys. Journ. 22. pp. 84–86, July, 1905.)—Recent observations obtained with the Lowell spectrograph have been combined with all previous values from other stations. The reduced velocities vary from — 19 to — 0·8 km. Its period is, excepting the secondary period of Polaris, the longest yet met with among spectroscopic binaries. C. P. B.

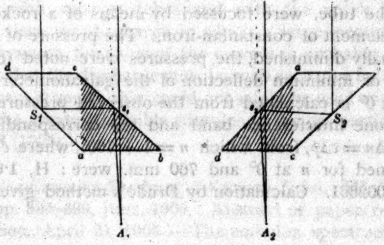
2039. *How a Planetary Nebula Commences Rotating.* **W. Holtz.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 3. pp. 236–237, 1905.)—A discussion as to how the rotation of a planetary nebula originates. The rotation is attributed to the gravitational attraction and the asymmetry, but the question is raised as to whether the asymmetry is due to the attraction or pre-existed. E. H. B.

LIGHT.

2040. *The Black Spot in Thin Liquid Films.* **E. S. Johonnott.** (Phys. Rev. 20. pp. 388–389, June, 1905. Abstract of paper read before the Amer. Physical Soc., April 21, 1905.)—Under the microscope it is possible to distinguish as many as five black films. These break, one into the other, each succeeding film being thinner. Variation of the atmospheric pressure causes great changes in the character of the films; a sudden increase of pressure is accompanied by a rapid thinning of the film, adiabatic pressure being accompanied by increased vapour pressure and evaporation from the surface of the film. G. E. A.

2041. *Physical Properties of Glass and Chemical Composition.* **E. Zschimmer.** (Zeitschr. Elektrochem. 11. pp. 629–638, Sept. 22, 1905. Paper read before the Chem. Gesellschaft at Breslau, July 7, 1905.)—Gives a general account of the investigations into the relation between the chemical composition and physical properties of various glasses produced at the Jena works; some curves and data connecting the composition and optical properties are here published for the first time, also some curves representing the optical effects of equivalent proportions of various oxides on the same glass regarded as a solvent. The futility of regarding the physical properties as direct additive functions of the various constituents is emphasised. The connection between chemical composition and such properties as surface durability, hygroscopicity, resistance to chemical action and sudden changes of temperature, &c., are dealt with, and the applications of special Jena glasses to such purposes as laboratory ware, thermometers, gauge-glasses, and lamp chimneys are described in reference to the special physical properties concerned. The most recent Jena optical glasses having special transparency for ultra-violet light are next referred to [see Abstracts Nos. 52 and 512 (1904)], and their special advantages illustrated by means of absorption charts and a reproduction of an astronomical photograph. Finally, the author sets forth his views as to the chemical nature of glasses in general, regarding them as variable mixtures of a great number of elements in a fused flux, whose physical properties vary continuously with their composition; the laws of this variation are, however, so complicated that they have not yet been determined accurately even in the simplest cases. W. Ros.

2042. *Stereoscopic Experiments. Effect of the Widened Interval between the Object-glasses of the Zeiss Binoculars.* **C. Pulfrich.** (Zeitschr. Instrumentenk. 25. pp. 233–242, Aug., 1905. Communication from the Optical Workshops of C. Zeiss.)—In the larger Zeiss instruments, or double telescopes, the increased perception of relief due to the widened interval is very noticeable, the interval in this case being from 5 to 20 times the normal. In small hand instruments, where the ratio is only about 1¾, the stereoscopic effect is not so striking, but nevertheless exists. The author gives some tables of calculated results in proof of this statement, but the paper deals mainly with practical tests. By means of a special arrangement, such as that shown in the Fig., a single binocular is practically converted into two of equal power, one having widened objective-interval (W), the other normal interval (N). The impressions produced by the W and the N images can thus be directly compared. The case may be likened to that of an observer with two pairs of eyes, one pair wider apart than the other. The Fig. represents two rhomboidal prisms intended to be mounted in front of the objectives of a field-glass. The shaded halves are cut away in laminæ in the direction of vision, so that the "N" pair of rays reaches the eyes after direct passage in air through the prisms. The "W" rays, parallel to them, undergo twofold reflection in the prisms at the faces S and *s*. It is important to notice that the faces S, *s*, are inclined at a small angle, 20′, to one another, in opposite directions for the two prisms, so that the W image *for each eye* is thrown to the left of the N image (or to the right, as the case may be). The explanation of this precaution will suggest itself to any one who tries to look at the same time at two pencils held vertically, one directly behind the other, at different distances in front of him. The prisms should be adjusted, by rotating them around the axes of the objectives, so that when the instrument is pointed at a distant object the two images, W and N, appear to be at the same distance from the eyes. For the convergence of the observer's optic axes is then zero, and the distance apart of the eyes immaterial. When the prisms are thus adjusted, the convergence of the optic axes for all nearer objects also will be unaltered by the interposition of the prisms (the direction of the rays being unchanged by the double reflection at practically parallel faces). Hence the W image is seen under greater convergence than the N, and therefore appears nearer. A curious mental result of this is that the observer thinks the W image is smaller than the N, when both are really of the same angular extent, because he thinks it is nearer. The effect disappears on closing one eye. Some earlier experiments are also described. The paper closes with a suggestion for measuring distances at sea by stereoscopic means. The principle consists in repeating, for a series of near objects at known distances, the process described above of rotating one of the prisms till the two images of a distant object appear equidistant. The amount of rotation of the prism being noted in each case afterwards serves as a measure of distance. A. E.



2043. *Refraction Determination by New Method.* **Lœwy.** (Comptes Rendus, 141. pp. 157–168, July 17, 1905.)—The paper gives in outline a description of a new systematic method of observation devised by the author for accurately determining stellar refractions. It is based on the employment of prisms of various refracting angles before the objective of a telescope, whose faces are used as reflecting surfaces giving a constant deviation between the rays passed to the eye from the celestial spheres. Pairs of stars are selected which satisfy the necessary relative conditions,

so that observations of them will eliminate many of the errors hitherto so detrimental to refraction measures. The measures are repeated at definite epochs so as to determine the apparent varying distance of the components of these star pairs, and by rigid analysis of the corrected values it is found that an extremely delicate measure of the refraction constant can be obtained.
C. P. B.

2044. *Refractive Indices of Gases in the Infra-Red.* **J. Koch.** (Ann. d. Physik, 17. 4. pp. 658–674, Aug. 22, 1905. Phys. Inst. d. Univ., Upsala, June, 1905.)—The experiments were made to test Drude's electron theory as regards the infra-red rays in hydrogen, carbon dioxide, and oxygen. [See Abstract No. 3241 (1904).] The source of light was a magnesia cylinder in an oxygen coal-gas flame, the residual rays of which, after three reflections from gypsum surfaces, were passed through an interferometer of the original Jamin form, with plane-parallel reflectors of rock salt 35 mm. thick. The tube for the gases was fitted with plane-parallel end-plates of rock salt, and the rays, after emerging from the tube, were focussed by means of a rock-salt lens on a "point" thermo-element of constantan-iron. The pressure of the gas in one tube being gradually diminished, the pressures were noted for which there was a maximum or minimum deflection of the galvanometer. The change of pressure Δp at 0° is calculated from the observed pressure change for a displacement of one interference band and the corresponding change of refractive index $\Delta n = c\Delta p$, from which $n = 1 + 760c$, where c is a constant. The values obtained for n at 0° and 760 mm. were: H, 1·0001373; CO_2, 1·0004578; O, 1·0002661. Calculation by Drude's method gives the ratio e/m as $1{\cdot}49 \times 10^7$.
G. E. A.

2045. *Refractive Index of Air in Relation to its Density.* **L. Magri.** (Phys. Zeitschr. 6. pp. 629–632, Oct. 1, 1905. Translation and Communication from the Phys. Inst. d. Univ., Pisa.)—The refractive index of air is measured by means of a Jamin refractometer as the pressure is varied from 1 to 176 atmos. Tables are given showing corresponding values of refractive index (n), density (d), $K(n-1)/d$, $(n^2-1)/d$, and $(n^2-1)/d\,(n^2+1)$. The last function is the only one which is constant with change of index and density. [See also Abstract No. 836 (1902).]
G. E. A.

2046. *Magnetic Birefringence.* **A. Cotton** and **H. Mouton.** (Comptes Rendus, 141. pp. 317–319, July 31, and pp. 349–351, Aug. 7, 1905.)—From experiments on old "fer bravais" the authors have found the following new facts. If the liquid is filtered through a collodion partition, the unfiltered portion possesses enormous magnetic birefringence, whilst the colourless filtrate is totally inactive. When the liquid has stood for several months the lower, more opaque part is the more strongly birefringent. The granules causing this are ultramicroscopic and exhibit very energetic Brownian movements. When a saline coagulating solution is added to the liquid in the magnetic field birefringence does not disappear completely when the current is stopped. Further, the vibrations parallel to the lines of force suffer a diminution of index nearly double the increase in that of the perpendicular vibrations. Very active positive liquids may be obtained from ferric hydroxide by submitting the liquid, sealed in a tube, to more and more prolonged heating at 100°. As the liquid becomes more active it also becomes more viscous and opaque; and ultramicroscopic examination shows that the size of the granules is increased by the heating. The grey liquid formed by pulverising iron electrodes in glycerine by Bredig's method, causes rotation of the plane of polarisation irrespective of the sense of the field. Dilute solutions of sodium carbonate and calcium nitrate form, when mixed, a liquid which presents negative magnetic birefringence accompanied by magnetic rotation, the effect being due to small crystals held in suspension. It is considered that the effect is observed only when the size of the suspended particles lies within certain limits. G. E. A.

2047. *Argon Lines in Air.* **A. S. King.** (Astrophys. Journ. 21. pp. 344–350, May, 1905.)—A series of experiments undertaken to determine the best conditions for making a very small percentage of a gas spectroscopically visible. In the case of air and argon more specially cited, the essential condition to bring out the argon spectrum from very small quantities of the gas seems to be a high momentary value of the current intensity produced by the conditions attending the oscillating discharge by which the line spectrum of the air or other gas is given. Such a discharge, both in the experiments with vacuum tubes and with the spark in air, proved more favourable than the discharge in which a large mean current-density was given, but in which the value of the current is probably more uniform. The conclusion is that the discharge must be such as to give for an exceedingly brief time a current strength that could not safely be used continuously, and in this way give the greatest possible stimulus to the gas particles. [See also Abstract No. 1388 (1905).] C. P. B.

2048. *Infra-Red Emission Spectrum of Vacuum Tubes.* **W. W. Coblentz.** (Phys. Rev. 20. pp. 395–399, June, 1905. Abstract of paper read before the Amer. Physical Soc., April 21, 1905.)—The emission spectrum of a vacuum tube is found to consist of two types of radiation, a thermal band at $\lambda = 4{\cdot}75\,\mu$ and irregular radiations (luminescent) above $\lambda = 2\,\mu$. In the case of nitrogen, bands were observed at 0·53, 0·66, 0·75, 0·90, and 1·06 μ. There are no irregular radiations with a greater wave-length than $2\,\mu$. The behaviour of the above bands was observed with changes of pressure or current. The thermal band increases with increasing pressure, but never reaches a maximum; the other bands, however, pass through a maximum at 2 mm. pressure. E. C. C. B.

2049. *Phosphorescent Spectra of Sδ and Europium.* **W. Crookes.** (Roy. Soc., Proc. Ser. A. 76. pp. 411–414, Aug. 4, 1905. Chem. News, 92. pp. 25–26, July 21, 1905.)—Recent examination of a pure specimen of europium prepared by Urbain has brought to light many facts connected with its phosphorescent spectrum when the sulphate is subjected to kathode radiations in a radiant matter tube. Previous work has shown that the anomalous line λ6094, ascribed to an unknown element Sδ by Crookes, is not identical with lines near the same wave-length found in new rare earths by Boisbaudran and Demarçay. The line given by Boisbaudran as due to Ze is broad and indistinct at the edges, while the anomalous line 6094 is absolutely sharp and narrow, like a gas line. Neither are their wave-lengths identical. It was found that the addition of a little lime entirely suppressed the line 6094. It was further found that in samaria prepared from different minerals the line varied greatly in intensity; for instance, the earth from samarskite showed it strongly, while samaria obtained from gadolinite showed no trace of the line λ6094, and therefore it follows that the body in question could not be samarium, yttrium, or a mixture of these two elements. Europium sulphate phosphoresces red, and a photographic analysis showed a complete absence of phosphorescence bands between λ4800 and λ2536. The visible spectrum consists almost exclusively of two red lines (the most refrangible being nebulous and faint, the other sharper and very bright) and a faint nebulosity in the position of the sodium line. Careful measurements show that the strong line is not coincident with the old "anomalous" line, but that it has a wave-length about λ6128. Again, while the addition of lime causes the line λ6094 to disappear, this same procedure does not cause the extinction of the europium line, but it is displaced to the red from λ6128 to λ6158, and at the same time the less-refrangible nebulous companion line is increased considerably in intensity. C. P. B.

2050. *Spectrum of Radium Radiation.* Part III. *Radiation in Hydrogen.* **W. Huggins** and **Lady Huggins**. (Roy. Soc., Proc. Ser. A. 76. pp. 488–492, Sept. 13, 1905. Astrophys. Journ. 22. pp. 204–208, Oct., 1905.)—When radium bromide was sealed up in hydrogen the glow became fainter and fainter until after a few days the strongest band only of the nitrogen spectrum was visible upon the photographic plate. Not long afterwards the salt began to turn a dark russet-brown, and finally a new glow made its appearance. On taking the salt out into the air this new glow entirely disappeared after 8 hours. After standing in air for 3 months it regained its normal condition. The glow developed in the hydrogen atmosphere shows a green band in the spectrum which has not been identified. [See also Abstracts Nos. 103 and 2597 (1904).] E. C. C. B.

2051. *Kathode Luminescence of Crystals.* **A. Pochettino.** (Accad. Lincei, Atti, 14. pp. 220–228, Aug. 20, 1905.)—The present paper contains further experimental data, also details as to the author's method of working. [See Abstract No. 78 (1905).] Specimens of the following exhibited a luminescence partially polarised normal to the axis z or, in case of hexagonal crystals, to the main axis—scheelite, phosgenite, apatite, witherite. A second specimen of witherite gave a fluorescence without any trace of polarisation. Zircon, anatase, beryl, and cerussite gave a fluorescence with polarisation parallel to the axis z or its equivalent. Two specimens of diopside were examined; the faces (100) gave an orange fluorescence with "normal" polarisation, the faces (010) a scarlet fluorescence with "parallel" polarisation. We have thus an unusual instance of dichroism under the action of kathode rays. Three out of five samples of chrysoberyl gave a blue fluorescence devoid of all polarisation. Two others gave a reddish fluorescence with polarisation parallel to the axis z. D. H. J.

2052. *Ultra-violet Fluorescence by Röntgen and Kathode Rays.* **P. Schuhknecht.** (Ann. d. Physik, 17. 4. pp. 717–727, Aug. 22, 1905. Extract from Inaugural Dissertation, Leipzig.)—It is possible, from Stokes' law, that the fluorescence produced by Röntgen rays contains quite short wave-lengths, but, owing to the small intensity of the light obtained with the Röntgen rays, the author uses mostly kathode rays. The examination, both with the eye and by photograph, of a large number of minerals, chemical compounds, and solid solutions of salts, gives no indication of any marked regularity in the dependence of the fluorescent light on the chemical nature of the substance; the colour of the fluorescence appears, however, to be a function of the metal, the acid radical only influencing the intensity of the light. Visible light and photographic action generally run parallel, but with barium and lead compounds photographic action often appears without visible light being observed. The limits of the spectra and their maximal intensities are given. The fluorescence from barium fluoride reaches farthest into the ultra-violet, and after this come zircon, fluorite, and barytes. T. H. P.

2053. *Radiation from Metals.* **G. Melander.** (Ann. d. Physik, 17. 4. pp. 705–716, Aug. 22, 1905.)—It was sought to determine whether the action of metals on sensitive photographic plates could be increased by raising the temperature. Observations were made upon the effect produced upon a photographic plate when a rod-shaped thermopile was placed near it through which a current was sent for some hours. The darkening produced upon the plate seemed due in some cases to the action of a gas; in other cases the effect did not appear to be due to a chemical action caused by a gas produced at the surface of the metals. The results obtained indicate that the action of different substances at the same temperature can be very various. The action proceeds not from a feeble chemical activity of the heat-rays, but from the actual presence of violet or ultra-violet radiation. It appears to the author that metals send out violet and ultra-violet rays at ordinary temperatures, and this radiation becomes more intense as the temperature is raised. From observations of the action at the junction of two metals in a thermo-element it would appear that the place of contact plays no noticeable part in relation to the radiation of energy, and that it is probable that the cause of the thermo-current must be sought not in the place of contact but in the peculiarities of the two joined metals. J. J. S.

2054. *Ionisation of Gases.* **J. Radakovits.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 759–783, June, 1905.)—A record is given of observations on the ionisation produced in gases by hot wires of various metals made to glow by the passage of an electric current. The positive and negative fall of potential was observed by means of an Exner's electroscope, and two sets of observations were made, one at atmospheric and somewhat lower pressures, the other in highly rarefied gases, the vacuum being that of the glow lamp. The results of the observations are given in a series of tables and curves. J. J. S.

2055. *Charging Effect of Röntgen Rays.* **K. Hahn.** (Ann. d. Physik, 18. 1. pp. 140–171, Oct. 12, 1905. Extract from the Giessen Dissertation, Dec., 1904.)—In addition to the ionising and discharging effects of the Röntgen rays, the author's experiments show that a charging effect is also obtainable. The chief results may be summarised as follows:—(1) All bodies which directly receive Röntgen rays are thereby positively charged. (2) Very thin metals are charged more strongly than thicker plates of the same material, and the difference is the more marked the shorter the exposure to the rays. (3) The influence of character of surface is trifling. (4) The potential of the plate receiving the rays is dependent (*a*) on the capacity with which the plate is connected. The quantity of electricity is smaller for small capacities and high potentials. If this is to be ascribed to the conductivity of the air, then it may be considered that the quantity of electricity generated by given rays is constant; (*b*) on the time of exposure to the rays. The potential increases with time up to about 20 seconds and then remains nearly constant; (*c*) on the kind of rays. Hard rays yield a stronger charging effect than soft ones; (*d*) on the kind of metal. The potential is greater the greater the atomic weight of the metal and the more strongly electro-negative it is; (*e*) on the surrounding gas. In air the potential is greater than in CO_2.

(5) Secondary rays give an opposite charging effect; hence the discrepant results of different observers as to paragraph 1. [See also Abstracts Nos. 2849 (1901), 684 (1902), 2889 and 2891 (1904).] E. H. B.

2056. *Emanations from the Uraniferous Minerals of Colmenar Viejo.* **J. Munoz del Castillo.** (Real Acad. de Ciencias, Madrid, 1. 6. pp. 442–444, Oct., 1904.)—Owing to the marked activity of the chalcolite previously examined [see Abstract No. 1878 (1905)], the author investigated whether it could excite an induced radio-activity. A plate of lead was exposed for ten days to the mineral, and the results obtained from several experiments are set out in tables. Although sufficient experiments have not been made to be quite conclusive, it is considered proved that the minerals emit an emanation, or rather two emanations, one being a very fleeting one and the other a more slowly decaying one. It is considered that the mineral must contain either radium, actinium or thorium, or else some new radio-active element. (Ibid. 2. 2. pp. 72^1 72^4, March, 1905.)—Further experiments are described. L. H. W.

2057. *Actinium and Emanium.* **W. Marckwald.** (Ber. Deut. Chem. Gesell. 38. pp. 2264–2266, July 8, 1905. Chem. News, 92. p. 92, Aug. 25, 1905.)—The identity of Debierne's actinium, which follows the reactions of thorium, with Giesel's emanium, which follows the reactions of lanthanum, has been assumed as a consequence of the identity of their emanations. The author's observations indicate that emanium itself gives no emanation, but yields actinium in much the same way as that in which thorium yields ThX, and the whole of the emanation is produced by the actinium. Thus a mixture of radio-active lanthanum and didymium oxides when freed from thorium gave no emanation; some months later the same mixture again gave the emanation strongly, but when dissolved in hydrochloric acid, together with a little thorium oxide, almost the whole of the emanating power was carried down when the thorium was precipitated by thiosulphate, and the recovered didymium-lanthanum oxide was only feebly active. T. M. L.

2058. *Production of Radium from Uranium.* **B. B. Boltwood.** (Amer. Journ. Sci. 20. pp. 239–244, Sept., 1905.)—Soddy's results [see Abstract No. 1585 (1905)] are questioned. It is pointed out that no data have been given to show how free his solutions were from radium at the beginning of the tests, and that the method he employed of removing the emanation from the solution was altogether inadequate. Actual boiling of the solution is necessary. The author's experiments, extending over 18 months, have shown no trace of the formation of radium from uranium, although the electroscope was capable of detecting one two-millionth of the quantity that would be necessary for radio-active equilibrium. R. S. W.

2059. *Disintegration Products of Radio-active Elements.* **B. B. Boltwood.** (Amer. Journ. Sci. 20. 253–267, Oct., 1905.)—A discussion of the data obtained from the analyses of minerals, and suggestions as to what may be the final products of disintegration. The importance of knowing the relative ages of the rocks investigated, from geological data, is pointed out. With reference to Strutt's suggestion that thorium is the parent of uranium, it appears his thorium minerals containing uranium are all old, while those containing uranium but no thorium are of relatively recent origin. The data available, the author considers, are rather in favour of uranium being the parent. For the reasons advanced for supposing that lead, bismuth, barium, the rare earths, hydrogen, and argon are the final products, the original paper must be consulted. R. S. W.

2060. *Absorption of β- and γ-Rays of Actinium.* **T. Godlewski.** (Phil. Mag. 10. pp. 375–379, Sept., 1905.)—It is found that the β-rays from actinium are homogeneous in character, and that their penetrating power does not change with the thickness of matter traversed. The second characteristic property of the β-rays of actinium is their relatively small penetrating power. While the β-rays from uranium are half absorbed in passing through the thickness of 0·5 mm. of aluminium, the β-rays of actinium are reduced to half value by 0·21 mm. Thus the β-rays of actinium have only 40 per cent. of the penetrating power of those of uranium, while the *average* penetrating power of the β-rays from radium is more than three times as great as for actinium. It is further shown that the γ-rays of actinium have a penetrating power of only about one-tenth of that of the more penetrating rays of radium. [See also Abstracts Nos. 1588 and 1590 (1905).] E. H. B.

2061. *Range of α-particles of Radium.* **W. H. Bragg** and **R. Kleeman.** (Phil. Mag. 10. pp. 318–340, Sept., 1905. Paper read before the Royal Society of S. Australia, June 6, 1904.)—The authors have improved the apparatus previously used by them, and have repeated their observations on the range of the α-particles from radium. The fact that there are four sets of these differing only in velocity is clearly established. The loss of range, in consequence of their passage through various substances, leads to the extremely simple law that the loss in traversing any atom is nearly proportional to the square root of the weight of that atom. In the case of a complex molecule the loss is proportional to the sum of the square roots of the weights of the constituent atoms. The substances on which observations have been made are the following : Gold, platinum, tin, silver, copper, aluminium, air, methyl bromide and iodide, carbon tetrachloride, ether, and hydrogen. Instead of giving numbers showing the stopping powers of strata of different materials of the same weight, they are referred to layers containing the same number of atoms, an imaginary air atom of atomic weight 14·4 being taken as having unit stopping power. For example, for equal weights, silver stops 1/2·41 times as much as air, for equal number of atoms 108/14·4 × 2·41 times as much, *i.e.*, 8·11, and this is taken as the stopping power of silver. The law of absorption as given by the usual exponential equation is considered to be altogether untrue. From a discussion of the results the following conclusions are arrived at : (1) That the α-particle makes the same number of ions during its course no matter what the gas it traverses ; (2) that the energy required to make a pair of ions is always the same ; and (3) that the observed variations in the conductivities in some cases are due to the failure of ions to get free from the molecule in which they are made. R. S. W.

2062. *Properties of the α-Rays.* **H. Becquerel.** (Comptes Rendus, 141. pp. 485–490, Sept. 11, 1905. Phys. Zeitschr. 6. pp. 666–669, Oct. 15, 1905.)—The author has shown that the radius of curvature of the path increases with the length of the trajectory when the rays are deviated by a magnetic field [see Abstract No. 1352 (1904)]. The simplest hypothesis to explain this is that the particles condense other matter round them, and so increase their mass. He has also shown that the beam of α-rays emitted by a radium salt is homogeneous. Bragg and Kleeman have advanced the view that at least four sets of α-rays are emitted with different velocities [see preceding Abstract], and this has been supported by Rutherford. One half of a beam of rays is now passed through different thicknesses of Al-foil and the other half through air. When deviated by a magnetic field, the trace obtained on a plate shows no discontinuity at the junction of the two halves, and it is therefore concluded that the velocity is still the same in both portions. Rutherford's idea as to phosphorescence being due to ionisation is also questioned. R. S. W.

2063. *Formation of Helium from the Radium Emanation.* II. **F. Himstedt** and **G. Meyer.** (Ann. d. Physik, 17. 5. pp. 1005–1008, Sept. 26, 1905. From Freiburger Ber. 16. p. 10, 1905.)—(1) Duplicate experiments in which barium bromide was used in place of radium bromide never gave any indication of helium; the latter cannot, therefore, have come from the atmosphere. (2) Neither can the gas have been occluded in the bromide as in the helium minerals. Thus cleveite, after yielding one or possibly two quantities of helium by successive heatings, gives no further indications of helium. (3) Further proof was obtained by twice heating radium bromide in a vacuous quartz tube so strongly that the salt was sublimed from one end of the tube to the other and back again; six weeks later the helium spectrum appeared without heating; occluded helium must certainly have been liberated when the salt was vaporised. (4) The presence of a radium helide in the salt is improbable, since this must be assumed to withstand heating but, nevertheless, to decompose at ordinary temperatures. [See also Abstract No. 3195 (1904).] T. M. L.

2064. *Emission of slowly moving Kathode Rays by Radium and Thorium Emanations.* **Miss J. M. W. Slater.** (Phil. Mag. 10. pp. 460–466, Oct., 1905.)—J. J. Thomson has shown that certain radio-active substances emit slowly-moving, negatively electrified particles. It is now shown that radium and thorium emanations also possess this property. A small tube containing radium or thorium is sealed and placed in a vessel in which is an electroscope. The capsule is broken by allowing a lump of iron to fall on it, immediately a large increase in the leak is obtained, if the charge on the electroscope is positive. This cannot be due to the excited activity, and moreover, if the source of the emanation is removed, the decrease in the leak falls to half value in about four days, as does the quantity of emanation present. These results confirm the suggestion of Thomson that the excited activity appears on a negatively electrified surface because the emanation emits a negative particle, leaving the part concerned in the excited activity positively charged. R. S. W.

REFERENCE.

2065. *Photographic Irradiation.* **A. Guébhard.** (Comptes Rendus, 141. pp. 420–422, Aug. 28, 1905.)—Having verified that the part of the irradiation called "tangential" [see Abstract No. 1745 (1905)], but which it would be more correct to call simply "lateral," corresponding to the incidence $\theta > \pi/4$ of Abney's hypothesis, did not conform with the latter, an explanation of the mutual repulsion at the edges of two irradiations is sought in electrical causes or by means of a species of intra-atomic gravitation. Experiment eliminates the former probability, and irradiation is concluded to be a property of matter as general as photographic sensitiveness itself. G. E. A

HEAT.

2066. *Gas-regulators for Thermostats.* **T. M. Lowry.** (Chem. Soc., Journ. 87. pp. 1030–1034, July, 1905.)—The author describes (1) tests made to determine the efficiency of gas-regulators of different patterns, and (2) two new and especially sensitive types of regulator. In one of the latter, the cylinder of toluene usually employed is replaced by a fluted cylinder consisting of a series of flat bulbs about 2 in. diam. and 1 in. high ; in the other, the liquid is enclosed in a long spiral of glass tubing. Both of these forms give greatly increased steadiness of the mean temperature, which does not vary by 0·01° in the course of a month, and also very small deviations from the mean. Owing to the slight elasticity of the spiral or fluted cylinder, the mercury trembles when the bath is stirred and so causes the flame, instead of coming on and off at regular intervals, to flicker constantly, the temperature of the bath being maintained without oscillation within 0·001° or 0·002° of the mean. To ensure close regulation of the temperature, it is desirable to make the by-pass as large, and the supply of gas passing through the regulator as small, as is practicable. A fall in the atmospheric temperature increases the amplitude of the temperature oscillations, but this may be avoided by increasing the size of the by-pass aperture. It is found, also, that when the mercury is contained in a narrow tube (2 mm. diam.), variations of the gas pressure do not necessarily alter the temperature of the bath. T. H. P.

2067. *Specific Heat of Air at Low Temperatures.* **J. S. Shearer** and **R. C. Fenner.** (Phys. Rev. 20. pp. 172–173, March, 1905. Abstract of paper read before the Amer. Physical Soc., Dec. 30, 1904.)—Air from a compression cylinder is passed through liquid air, the amount passed in and that vapourised being measured by two gas meters. A steel-constantan thermo-couple in conjunction with a potentiometer is used for measuring the temperature drop. The meter readings were photographed at intervals by flash-light. The results have not yet been fully worked out, but the specific heat of air over a range of 180° agrees very well with previous determinations. S. G. S.

2068. *Specific Heat and Latent Heat of Fusion of Potassium and Sodium.* **A. Bernini.** (N. Cimento, 10. pp. 5–13, July, 1905.)—The variation of specific heat with change of temperature, between 0° and 157° C., has been determined for both metals, and their latent heats of fusion deduced from the values thus obtained for the solid and liquid states. In both cases the specific heat increases rapidly with rise of temperature, but faster with sodium than with potassium, thus according with earlier experiments in which the lower the atomic weight of an element, the greater was the variation of its specific heat with temperature. The calculated latent heats of fusion are 13·61 and 17·75 cal. for potassium and sodium respectively. W. H. St.

2069. *High-Temperature Radiation.* **P. G. Nutting.** (Astrophys. Journ. 21. pp. 400–409, June, 1905.)—Various suggestions are given as possible explanations of the origin of high-temperature radiation. The chief conclusion is that electromagnetic radiation may originate in material bodies when these bodies contain sources of one or all of the three following types: (*a*) Electrically-neutral aggregates of charged particles that possess no finite external electromagnetic field when undisturbed ; (*b*) Aggregates possessing a finite external field, which may or may not be electrically neutral as to total charge ; (*c*) Individual charges or charged particles moving independently of one another and of aggregates of particles. Excitation of an electrical, mechanical or thermal nature suffices to excite these three types of source : type (*a*) to lined spectral radiation ; types (*b*) and (*c*) to radiation of the black-body type. To account for the broadening of spectral lines or the emission of continuous spectra, it is unnecessary to assume damping of the radiation. Bodies possess in general, not only a fusion temperature and temperature of vaporisation, but an ionisation temperature lying within the range of from 8,000°-10,000° for elementary gases, and lower for other substances. Purely thermal heating of a body to the neighbourhood of its ionisation temperature is sufficient to cause radiation. It would be difficult, if not impossible, to heat a body by electrical or thermal means above its ionisation temperature, hence there is an upper limit not exceeded by stellar temperatures. C. P. B.

2070. *Specific Heat of Iron at High Temperatures.* **J. A. Harker.** (Phys. Soc., Proc. 19. pp. 703-712, Oct., 1905. Phil. Mag. 10. pp. 430-438, Oct., 1905.)—The method of mixtures is employed, the iron being contained in a thin tube of glazed porcelain. The specimen is heated electrically, its temperature being determined by a platinum thermometer in the first experiments, and by a thermo-couple in the later experiments where a much higher temperature was required. The mean specific heat between 0° and any other temperature is tabulated ; it increases from 0·1175 at 200° to 0·1647 at 850°, and then falls to 0·1534 at 1,100°. S. G. S.

2071. *Density of Chlorine at High Temperatures.* **M. Reinganum.** (Phys. Zeitschr. 6. pp. 514-516, Aug. 15, 1905.)—An apparatus for determining the above quantity consists of a quartz bulb connected by a long capillary tube, with a three-way cock, to another bulb surrounded by a water-jacket. The second bulb communicates with a collecting vessel in a pneumatic trough. Air and then chlorine are filled into the quartz bulb which can be raised to a temperature of 1,137° C. in an electric furnace. Observation of the volumes of air displaced in each case from the second bulb leads to the value of the density of chlorine. No noticeable dissociation of the chlorine was observed at 1,137°, the weight of the collecting vessel and displaced air being respectively 114·34 gm. with air, and 114·03 gm. with chlorine. G. E. A.

2072. *Elastic Properties of Steel at High Temperatures.* **B. Hopkinson** and **F. Rogers.** (Roy. Soc., Proc. Ser. A. 76. pp. 419-425, Sept. 13, 1905. Engineering, 80. pp. 331-332, Sept. 8, 1905.)—Deals with the elastic properties of steel at temperatures up to 800° C. and stresses greatly below those required to rupture the material. Steel at such high temperatures behaves like india-rubber or glass ; if it is stressed for a time, and the stress removed, it does not at once recover, but after immediate recovery there is a slow contraction which is perceptible for many minutes. Such "creeping" can be detected at ordinary temperatures, but at a red heat it attains a different order of magnitude, becoming, in its total amount, a substantial fraction of the whole deformation. The test-pieces were heated by means of an electric tube-furnace, and the temperature was kept uniform over the entire length of the thin portion of the test-piece ; extensometer measurements, however, included the extensions of the thicker ends of the specimen and of connecting pieces whose temperature could not be so accurately ascertained, so that the elastic data found only justify the general conclusion as to the order of magnitude of the creeping. W. Ros.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

2073. *Electrical Vibrations between Confocal Elliptic Cylinders.* **J. W. Nicholson.** (Phil. Mag. 10. pp. 225–236, Aug., 1905.)—The surfaces are assumed perfectly conducting, thus making the magnetic induction tangential and the electric force normal. The general case is devoid of simplicity, but the author finds that it furnishes results of great elegance when the solution is merely carried to a close approximation. The treatment is necessarily highly analytical, but the chief results may be expressed in words as follows: The most general type of oscillation possible in the space consists of the combination of (1) waves of a doubly infinite series of possible periods travelling round the common axis of the cylinders; (2) waves of any period whatever travelling along the axis. In this general vibration the path of a ray is a spiral curve round the axis of the cylinders, and the following results will hold: (*a*) The magnetic force never has a component normal to the confocal elliptic cylinder through any point; (*b*) the electric force never has a component along the axis of the cylinders. E. H. B.

2074. *Fundamental Experiment in Electric Potential.* **A. M. Worthington.** (Phil. Mag. 10. pp. 380–383, Sept., 1905.)—The object of this experiment was to ascertain whether any difference could be detected between space at a high electrical potential and space at a low potential, quite irrespective of the existence of any electric field in the space in question. Any easily noticeable difference was not to be expected. Such would probably have been long since discovered; for, if it exists, it can only correspond to some small residue of energy not accounted for in the well-established relations of the electric field. The author tested the question at issue by observing whether any difference could be detected in the velocities of light passing through two tubes, the interior of one of which was at a high, and of the other at a low, potential. The arrangement employed was that of a Rayleigh interferometer, the source of light being a Cooper Hewitt mercury-vapour lamp. The difference of potential used was about 60,000 volts. No shift of the interference bands could be detected either when the spark discharge occurred or while the potential difference was accumulating. The experiment showed that a difference of potential of 60,000 volts does not, in a length of 152 cm. of air, produce a relative retardation of as much as $(57/20) \times 10^{-6}$ cm. In other words, if there is any difference in the velocities through the tubes, it is less than 1/53 of one-millionth of the whole. [See Abstract No. 1554 (1905).] E. H. B.

2075. *Proof Planes and Conductors.* **R. P. Schaffers.** (Annal. Soc. Sci. de Bruxelles, 29. pp. 214–218, 1904–1905.)—The paper is a short discussion of the applicability of proof planes and conductors of various shapes for the measurement of surface density of electrification. The author concludes that in the case of a body of irregular shape the method is not applicable, but in the case of a plane or symmetrical surface a small proof plane or hemisphere may be used; the shape of proof conductor most free from objection is the sphere. S. G. S.

2076. *Experiments with the Electric Wind.* **J. R. Januszkiewicz.** (Phys. Zeitschr. 6. pp. 581–582, Sept. 15, 1905.)—Two lecture experiments are described, the first of which is intended to show that the discharge between the knobs of an electrical machine is oscillatory. The electric wind from a point attached to one knob will discharge an electroscope protected by an earthed net when the charges are of opposite sign, but not when they are of the same sign; if, then, a discharge occurs between the knobs, the electroscope is discharged, whatever the original sign of the charge on the knob. The reason is that the wind from the point changes sign at every oscillation of the charge between the knobs. The second experiment shows that a negative electric wind is stronger than a positive one. A balance is obtained between the electric attraction between two spheres and the repulsion due to the electric wind from a point on one of them facing the other. If a point of balance be found when the wind is positive, then on reversing the polarity of the electrical machine the repulsion, on account of the wind, is seen to be increased. S. G. S.

2077. *Electric Wind.* **R. P. Schaffers.** (Annal. Soc. Sci. de Bruxelles, 29. pp. 417–446, 1904–1905. Phys. Zeitschr. 6. pp. 614–617, Oct. 1, 1905.)—Experiments are described which show that the phenomenon of electric wind is not simple, but that at least three operations are going on. The first is the effect of form of a fluid conductor in an electric field; the second is the effect of the repulsion of the charged conductor on the charge of the same sign which it communicates to the air; and the third is the stream set up in the air by the friction of the ions shot out from the point. The first effect is made obvious by using a flame, of which the blue part is negatively and the yellow part positively charged, and placing a glass plate between it and the point. If the point is positively charged, the yellow part is repelled and the blue part attracted, and *vice versâ.* If the plate is replaced by an earthed wire net, the repulsion due to the air stream (second effect) is observed, and when no screen is used both effects take place simultaneously. The third effect is made evident by means of a little mill having aluminium vanes which, by a proper disposition of the conductors, may be made to rotate forwards, owing to the repulsion of a charge given to it by the ions from the point, or backwards by electric charges induced in it by influence. S. G. S.

2078. *Measurement of Vertical Electric Current in the Atmosphere by Balloons.* **H. Gerdien.** (Gesell. Wiss. Göttingen, Nachr., Math-Phys. Klasse, 3. pp. 258–270, 1905. Geophys. Inst., Göttingen, June, 1905.)—Measurements of potential gradient and of specific conductivity are made throughout the journey in the manner previously described [see Abstract No. 3247 (1904)]. Measurements of pressure, temperature, and humidity are also taken. The results are given in the form of a diagram which also shows the various kinds of cloud present at the time of the journey. It is found that although the values of potential gradient and conductivity vary among themselves as much as 1 : 25 and 1 : 27 respectively, the values of the vertical current do not vary among themselves by more than 1 : 4. S. G. S.

2079. *Atmospheric-Electric Currents in Vertical Wires.* **G. Weise.** (Beibl. Ann. d. Physik, 29. 4. pp. 210–211, 1905. Extract of Rostock Dissertation, 1904.)—An investigation of the atmospheric electric currents set up in a vertical wire insulated from the earth. The wire was set up near the Sternberg Polytechnic (Mecklenburg). The supporting mast was 24·5 m. high, and on a cross-arm 24 m. from the ground various pointed collecting structures were placed, including a circle of galvanised barbed wire, a number of pointed drilled carbon rods on copper wires, and a zigzag-edged zinc strip. From these collectors one wire led to the secondary of a transformer, the primary of which was connected to a galvanometer. On completing the secondary (to earth) the deflection produced was observed. The carbon-point arrangement was found to have a much greater absorbing power than the barbed wire, and this power increased with the number of carbons. The effect of a searchlight thrown on the electrode (which latter served as an equaliser between the negative earth and the positive atmosphere) is to increase the equalising current to four to eight times its previous value (perhaps owing to a Hallwachs effect, it is suggested), and the value of the current appears to be nearly inversely proportional to the atmospheric pressure. On the approach of thunder, after each discharge at 8 km. distance, an especially strong current was noticed. Numerous curves are given in the original paper. L. H. W.

DISCHARGE AND OSCILLATIONS.

2080. *Mechanism of Electrical Pulverisation.* **F. Braun.** (Ann. d. Physik, 17. 2. pp. 359–363, July 4, 1905. Phys. Inst., Strassburg, April 16, 1905.)—When the discharge of a Leyden battery is passed through a wire laid between two glass plates so much heat is evolved in a very short time (a few hundred-thousandths of a second) that the metal is volatilised and deposits itself on the glass plates in the form of gratings, in which the presence of metal-free strips has not yet been fully explained. That the metal is volatilised is proved from several circumstances: with suitable low discharge the wire is just melted, and then only quite close to the metal can a thin deposit be distinguished; with high discharges the glass plates are destroyed; and the higher the melting-point of the metal the more intense must the discharge be to produce pulverisation. The evaporation of the metal is also shown by means of a photograph. The spectrum of pulverised zinc wires, photographed by means of a quartz prism and lenses, was discontinuous, whilst that of carbon filaments was continuous. It was computed that the filaments were raised to 20,000°–30,000° C., and under the microscope the molten carbon particles had exactly the same appearance as those of molten metals. For several reasons it is not probable that the metal particles are oxidised, *e.g.*, zinc gives a dull black deposit, whereas zinc oxide is a white substance. The air is probably displaced by the metallic vapour so completely that the latter has cooled down when the air comes in contact with it again. In one experiment with alloys, in which a brass wire was pulverised between two horizontal glass plates, two vertical plates abutting on the ends, the zinc was deposited on the horizontal plates and the copper on the end plates. Platinum-silver alloys were separated in a similar manner. G. E. A.

2081. *Smallest E.M.F. Necessary to Maintain a Voltaic Arc.* **W. Mitkiewicz.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. Physical part, pp. 259–263, 1904.)—Owing to the fact that the kathode must be at a very high temperature, and, furthermore, that the impressed voltage must be greater than the counter-e.m.f. of the arc, a relatively high voltage is necessary to produce an arc. The anode temperature in the arc is generally much higher than that at the kathode, and therefore the resultant of the e.m.f. of the arc assists the anodic e.m.f. in opposing the current. If, however, the kathode is at the higher temperature, the resultant e.m.f. has the opposite sign. So that it should be possible to produce and maintain an arc at almost any low voltage, provided the kathode be kept at a sufficiently high temperature. The author was actually able to maintain an arc with only 2 volts and 2 amps. when the carbon acting as kathode was made white-hot by the aid of the oxygen blowpipe. [See also Abstract No. 597 (1904).] L. H. W.

2082. *Sparking Potentials with Different Metals.* **J. E. Almy.** (Phys. Rev. 20. pp. 382–384, June, 1905. Abstract of paper read before the Amer. Physical Soc., April 21, 1905.)—The influence of the material of the electrodes upon the kathode fall is now fully recognised. The author investigates whether the nature of the metal also influences the sparking potential. With freshly cleaned electrodes such an effect is always observed, the electrodes being spheres of 10 cm. radius. Since hydrogen brings out the influence on the kathode fall most clearly, this gas is also used for the sparking experiments. It is evident that the minimum sparking potential in a gas has no definite meaning unless the material of the electrodes is also specified. R. S. W.

2083. *Ionisation and Conductivity of a Coherer.* **R. Thöldte.** (Ann. d. Physik, 17. 4. pp. 694–704, Aug. 22, 1905. Écl. Électr. 45. pp. 75–77, Oct. 14, 1905.)—The radiation from radium bromide falls on the coherer for a considerable time, the resistance of the latter being tested at intervals. The radium preparation was tied under the tube containing the coherer particles. It is found that the conductivity of the coherer rises on account of the ionisation. Several commercial forms of coherer were used. [See also Abstract No. 1337 (1901).] P. E. S.

2084. *Discharge Phenomena in Vacuum Tubes.* **R. Fürstenau.** (Ann. d. Physik, 17. 4. pp. 775–778, Aug. 22, 1905.)—A new glow lamp which has been rubbed by the hand, a piece of silk, or the sleeve, and held in the hand or placed on a stand, remains dark for 8 or 10 seconds and then begins to glow feebly, the whole filament and the foot of the lamp becoming luminous. During this "secondary" glow the filament remains quiescent. If, while the lamp is on a stand, a rubbed ebonite rod is caused to vibrate 1 cm. above it, the lamp glows so long as the amplitude of the vibration of the rod attains a certain value. **R. Lohnstein** (Phys. Zeitschr. 6. p. 443, July 15, 1905.)—Lohnstein refers to a similar experiment of his own. G. E. A.

2085. *Electromagnetic Screening.* **K. Ogawa.** (Coll. Sci. and Engin., Mem. Kyōto, 1. pp. 140–144, 1904–1905.)—Between an oscillator circuit with spark-gap and a second in tune with it and containing a calorimeter, metallic loops and thin metallic foils are placed. Their presence reduces the effect received and recorded in the resonator circuit. Thus with gold-foil 0·00099 mm. thick the effect was reduced to 0·931 for waves of frequency $0·2 \times 10^6$ per sec. and to 0·819 for frequencies of about $1·6 \times 10^6$. With silver-foil 0·00165 mm. thick the corresponding fractions for the above frequencies were 0·619 and 0·506. E. H. B.

2086. *Evolution of Nitrogen from the Kathode and its Absorption by the Anode in Gases.* **C. A. Skinner.** (Phys. Rev. 21. pp. 169–180, Sept., 1905.)—Recently the author published some experiments which showed that the evolution of hydrogen and helium by the kathode and their absorption by the anode obeys Faraday's law [see Abstract No. 1768 (1905)]. In the present paper is described a continuation of the same experiments using carbon electrodes and nitrogen as the gas; in the same way the author claims that Faraday's law is again obeyed in this case. He therefore assumes the phenomenon to be general, and discusses the mechanism of the discharge from this standpoint. E. C. C. B.

2087. *Electrical Conductivity of Flames.* **H. A. Wilson.** (Phil. Mag. 10. pp. 476–485, Oct., 1905. Communicated by the Physical Society, June 16, 1905.)—A long coal-gas flame is produced by means of a quartz tube which has small holes along its length, and into this is led the mixture of air and gas from a Bunsen burner. If V_1 and V_2 are the sudden decreases in potential at the anode and kathode respectively, it is found that the current varies proportionally to $\sqrt{V_1 + V_2}$. If a salt vapour is introduced into the flame at any point, the current is not affected unless the vapour comes in contact with the negative electrode. This result was previously explained by supposing that ionisation occurs only at the electrode; it now appears the true explanation is that ionisation takes place everywhere in the flame and that the absence of effect except close to the kathode is due to the non-uniformity of the potential gradient, the introduction of the vapour causing an increase in the gradient at the kathode. The potential gradient is very small, except close to the electrodes. R. S. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

2088. *Comparison of Mutual Inductances.* **A. H. Taylor.** (Phys. Rev. 20. p. 393, June, 1905. Abstract of paper read before the Amer. Physical Soc., April 21, 1905.)—The same alternating current is sent through the primaries of the two pairs of coils, and across the secondary giving the higher e.m.f. is placed a very high resistance (5,000 to 100,000 ohms). If this resistance be made up of two parts, r_1 and r_2, then the e.m.f. over r_1 may be made to balance the e.m.f. of the secondary of the second pair of coils. Or, $M_1(r_1)/(r_1 + r_2) = M_2$, where M_1 is the coefficient of mutual inductance of the first pair of coils, and M_2 that of the second pair. For a mutual inductance of 0·035 millihenry the order of precision is about 0·1 per cent.; for inductances of the order of a few millihenries, about 0·01 per cent. F. E. S.

2089. *Variation of Inductance Standards with Temperature.* **A. H. Taylor.** (Phys. Rev. 20. p. 394, June, 1905. Abstract of paper read before the Amer. Physical Soc., April 21, 1905.)—The inductance L was of the Ayrton-Perry type and was placed in series with a capacity C in one arm of a bridge, the other three arms of which were ohmic resistances. The inductance had a resistance r_0 and was shunted with a resistance R, while the capacity was shunted with a resistance r, very nearly equal to R. The two proportional arms of the bridge were made equal, and R_1 was the resistance required to balance the arm containing L and C for steady currents. Then an alternating current was applied and balance obtained with an alternating-current galvanometer. The temperature of the box was raised 10° C., and the bridge balanced again. The results were in all cases practically negative. At least it is safe to say that for this standard, as probably for others of the same type, the variation of inductance with temperature is less than 1 in 40,000 per 1° C. F. E. S.

2090. *Determination of Inductances of Solenoids.* **B. Strasser.** (Ann. d. Physik, 17. 4. pp. 763–771, Aug. 22, 1905. Phys. Inst. d. techn. Hochschule, Danzig, June 24, 1905. Écl. Électr. 45. pp. 31–33, Oct. 7, 1905.)—For the inductance of a solenoid the following formula is obtained :—

$$L = 4\pi r \left\{ n\left(\log_\epsilon \frac{r}{\rho} + 0{\cdot}333\right) + n(n-1)\left(\log_\epsilon \frac{8r}{g} - 2\right) - A + \frac{g^2}{8r^2}\left[\left(3\log_\epsilon \frac{8r}{g} - 1\right)\left(\frac{n^2(n^2-1)}{12} - B\right)\right]\right\}.$$

In this r is the radius of the centre of the wire coils, ρ the thickness of the wire, n the number of turns, g the pitch of the solenoids, A and B being functions of n whose values are tabulated for n up to 30. The agreement between the results by this formula and those by Drude is very close. The comparison with experimental results was also satisfactory. [See Abstract No. 826 (1903).] E. H. B.

2091. *Diminution of Resistance by Action of Radium Rays on Bad Conductors.* **A. Righi.** (Accad. Lincei, Atti, 14. pp. 207–214, Aug. 20, 1905. N. Cimento, 10. pp. 113–122, Aug., 1905.)—The author has tested the statement that there is diminution of resistance when solid and liquid dielectrics are traversed by the rays from radio-active substances [see Abstract No. 836 (1904)]. For this purpose 15 mgm. of radium bromide enclosed in an ebonite capsule provided with a thin mica cover, were employed ; the liquids examined were petroleum ether, turpentine, carbon bisulphide, benzene, olive oil and vaseline, and the solids—paraffin, shellac, sulphur, &c. The principle of the method employed to ascertain if the resistance of the dielectric varied, consisted in allowing a current to traverse it, and observing if there was a variation of the e.m.f. between the electrodes which served to introduce the liquid or solid dielectrics into the circuit. The few solids examined gave negative results, and therefore the existence of an increase of their conductivity due to β-rays remains uncertain. Positive results were obtained for the liquids ; from the preliminary experiments described it appears that the increase of conductivity is considerable for olive oil and vaseline, a little less for the other liquids studied except carbon disulphide, which does not show a great difference. D. H. J.

2092. *Dielectric Strength of Double-refracting Crystals.* **J. E. Almy.** (Phys. Rev. 20. pp. 391–393, June, 1905. Abstract of paper read before the Amer. Physical Soc., April 21, 1905.)—The dielectric strength of crystals is measured to test the existence of a possible relation between it and the optical properties of such media. Plates of quartz, selenite, aragonite and Iceland spar are examined, and in none of these except quartz is there a clearly-shown difference in the dielectric strength depending on the direction of the discharge. The method depends on a measurement of the spark potential, and for each substance, except possibly Iceland spar, the spark potential may be expressed as a linear function of the thickness of the plate. G. E. A.

2093. *Effect of Radium Emanation on Conductivity of Water.* **U. Grassi.** (Accad. Lincei, Atti, 14. pp. 281–284, Sept. 3, 1905.)—The resistance between two parallel platinum plates situated in water is determined by the bridge and telephone method, at intervals after commencing to bubble hydrogen through it, both when the hydrogen has passed over radium bromide and when it has not. A considerable increase in the conductivity of the water is produced by the emanation carried by the hydrogen. The increase in conductivity is not constant and is greater, the longer the hydrogen has been in contact with the radium bromide. To ensure that no bromide is carried over with the hydrogen, the author passed the latter over $AgNO_3$ and NaOH before conveying it to the water: the conductivity was thereby much reduced. S. G. S.

2094. *Electric Phenomenon of Thin Insulating Films.* **H. Greinacher** and **K. Herrmann.** (Ann. d. Physik, 17. 5. pp. 922–934, Sept. 26, 1905. Physik. Inst. d. Univ., Berlin, July, 1905.)—If the thin film of gas separating two metals is made conducting we obtain something analogous to a voltaic cell, a difference of potential being exhibited. Various surfaces were used, such as magnesium, silver, and nickel. They were exposed to about 110 volts for varying times and the extent of the resulting polarisation after this treatment noted. The polarisations obtained range from 0·94 to 1·03 in one experiment, this value running down again to 1·01 after 10 minutes' short-circuiting of the cell. Other metals are also dealt with, many experimental details, curves and tables being given. [See also Abstracts Nos. 3256 (1904) and 1641 (1905).] E. H. B.

2095. *Electric and Dielectric Behaviour of Conductors of the Second Class.* **C. Fredenhagen.** (Ann. d. Physik, 17. 2. pp. 332–345, July 4, 1905. Theoret.-physik. Inst., Leipzig, April, 1905.)—Chemical occurrences which are connected with the progress of binary equivalent combination are able to manifest themselves under suitable conditions as an electric current. Increasing molecular forces favour a similar course of the display of chemical action. There exists thus a parallelism between the electric behaviour of the conductors of the second class and the molecular forces acting in them. The dielectric behaviour of the conductors depends on the completeness of the binary equivalent combination, their electrolytic conductivity on the absolute amount of the united products of decomposition, and besides on their migration velocities. J. J. S.

2096. *Study of Dielectric Liquids.* **P. Gouré de Villemontée.** (Comptes Rendus, 141. pp. 179–181, July 17, 1905.)—The author has made experiments to ascertain the duration of the charge and the electric condition of the mass after the charge. He used two cylindrical condensers filled with light petroleum and paraffin oil respectively, and charged with Daniell and Gouy cells respectively. The results obtained were similar to those found by Curie in his work on the conductivity of crystallised bodies; the propagation of an electric charge through petroleum or paraffin is comparable with the transmission of the charge through crystalline bodies. A similar analogy has already been signalised by Hertz as existing between the properties of benzene and crystals. D. H. J.

2097. *Deviation of Dielectric Ellipsoid in an Electric Field. Specific Inductive Capacity of Water.* **F. Beaulard.** (Rev. Électrique, 4. pp. 119–121, Aug. 30, 1905. Paper read before the Cherbourg Meeting of the Assoc. franç. pour l'avancement des Sciences, Aug., 1905.)—The water is contained in an ellipsoidal glass vessel suspended in an electrostatic field, the axes of the ellipsoid being all inclined to the field. The couple acting on it is determined when empty and when containing water, and since the former is very small the difference is considered to be that due to the water. A high-frequency alternating field is employed, in order to avoid the effects of permanent electrification. Kelvin's calculation of the couple in terms of field, dimensions of ellipsoid, and the specific inductive capacity is given, and the last quantity calculated for water. It is found to be 11·04. The author thinks that the usually accepted value, 80, is too high, owing to the capacity as determined in the ordinary way being too high on account of a polarisation effect. S. G. S.

2098. *Efficiency of Spark Coils.* **C. A. Carpenter.** (Elect. World and Engineer, 46. p. 400, Sept. 2, 1905.)—In reply to an editorial (Ibid. pp. 254–255, Aug. 12) pointing out the lack of data as to efficiency of spark coils, the author communicates the results of tests of two comparatively small coils. The watts input of the primary was measured with a Weston wattmeter, the current by hot-wire ammeter. The current in the secondary was determined by means of the lamp bridge [see Bedell, Abstract No. 1632 (1905)], and the heat developed at the spark by a calorimeter previously calibrated by a direct current. All energy not accounted for in the secondary copper loss and the spark was taken as the iron loss. The coils were tested in continuous operation, one, by Kohl, being a laboratory coil, and the other an Apple gas-engine coil.

Coil tested.	Kohl.	Apple.
Primary input, watts	7·89	6·3
Primary copper loss, watts	1·3	0·52
Primary copper loss, per cent.	16·5	8·25
Secondary copper loss, watts	0·49	1·3
Secondary copper loss, per cent.	6·2	20·6
Developed in spark, watts	0·9	1·08
Developed in spark, per cent. (efficiency)	11·4	17·2
Total iron loss, &c., watts	5·2	3·4
Total iron loss, &c., per cent.	66·0	54·0

L. H. W.

2099. *Contact with Dielectrics.* **R. Appleyard.** (Phil. Mag. 10. pp. 485–497, Oct., 1905. Communicated by the Physical Society. Electrician, 55. pp. 984–987, Oct. 6, 1905.)—The chief object of the paper is to examine whether tin-foil electrodes pressed against a sheet of dielectric by indiarubber discs will enable accurate determinations of dielectric resistance to be made by the direct deflection method. The results obtained show considerable variations when either the load on the discs or the testing voltage is varied. These variations practically disappear if mercury electrodes are used. It is concluded that the method is suitable for rough tests only. R. S. W.

2100. *Kathode-glow Oscillograph.* **E. Gehrcke.** (Zeitschr. Instrumentenk. 25. pp. 278–280, Sept., 1905. Communication from the Physikal.-Techn. Reichsanstalt.)—The author describes the latest form of his kathode-glow oscillograph [see Abstract No. 823 (1905)]. A number of constructional refinements have been carried out, resulting in greater brightness being obtainable, whereby the instrument can now be used to take oscillograms of higher frequency currents (higher speed of rotation of the revolving mirror). The gaps below the minimum potential are now less apparent. Low-voltage currents can be measured if a superposed direct current of sufficiently high voltage be used, as was pointed out by Orlich (Deutsch. Physikal. Gesell. Verh. 6. p. 178, 1904), and oscillograms are reproduced of currents of frequencies 1,880 and 4,660 per sec., the direct current being supplied at 1,000 volts, and of magnitude 0·06 amp., while the alternating current was only of amplitude ± 0·009 amp. L. H. W.

ALTERNATING CURRENTS AND MAGNETISM.

2101. *Hysteresis at High Frequencies.* **C. E. Guye** and **A. Schidlof.** (Archives des Sciences, 18. pp. 576–598, Dec., 1904 ; 19. pp. 60–79, Jan., and pp. 159–187, Feb., 1905. Comptes Rendus, 140. pp. 369–370, Feb. 6, 1905.)—This series of articles deals in a thorough manner with the work that has been done on this subject. The results obtained by other workers, which are somewhat divergent, are carefully discussed in reference to the various experimental methods employed, the causes of discrepancy to some extent explained, and the results brought into line with the recent work of Guye and Herzfeld [see Abstract No. 1456 (1903)], and of the present authors [Abstract No. 3006 (1904)], who claim to have proved that over wide ranges of frequency the hysteresis loss per cycle is independent of the frequency. It is pointed out that eddy currents, if present, may have opposite effects. If the sample is not thin enough, these currents may shield the inside portions so that they are not properly magnetised at the higher frequencies, and *too small* a value of the loss is arrived at. On the other hand, with thinner samples, the eddy loss itself may, unless properly allowed for, cause the hysteresis loss at high frequencies to be stated to be *too high.* With thinner samples still (the authors used wires 0·0016 in. diam.), the eddy loss is really negligible, even at the highest frequencies employed (1,200 ∿ per sec.), but a new error arose in the authors' experiments on account of the small rise of electrical resistance of the sample when magnetised; for the hysteresis loss was derived by them from an electrical measurement of the rise of temperature which it occasioned in the sample wires, and this rise of temperature was so small when the wires were thin that the above-named effect was of importance. The articles conclude with an investigation into the dependence of hysteresis loss at high frequencies upon the magnetising limits. The effect of chemical composition on the magnetic qualities of various kinds of steel and of nickel is also experimentally dealt with. D. K. M.

2102. *Magnetisation by High-frequency Currents; Action of the Rutherford-Marconi Detector.* **E. Madelung.** (Ann. d. Physik, 17. 5. pp. 861–890, Sept. 26, 1905. Extract from Dissertation, Göttingen, 1905. Écl. Électr. 45. pp. 234–236, Nov. 11, 1905.)—The author considers that the published investigations of the effect of high-frequency currents on magnetisation drive one to take the view that the ordinary laws of magnetisation and demagnetisation must be modified when the velocity of the cyclic process is comparable with the frequency of such currents, the magnetising curves becoming what he terms dynamic magnetising curves. From this point of view the Rutherford effect is investigated for the purpose of obtaining a satisfactory explanation of its action and of that of the Marconi magnetic detector. The static magnetising curves are first discussed in a similar manner to that adopted by Ascoli [see Abstract No. 1047 (1905)]. The experimental part consisted in examining the cyclic curve, by a modified

Ångström method, with the Braun tube. Owing to the impossibility of direct photography, this curve was determined point by point on the sectionally ruled fluorescent screen. The core used was of hard-drawn steel wire, 0·7 mm. diam., and in the form of a nearly closed ring, and the high-frequency currents were produced by condenser discharges of frequency about 2,500, 1,250, and 625 per sec. Several curves obtained are reproduced as typical, and from these the author concludes that in the dynamic curves the magnetisation alters more slowly than one would expect from the rate of alteration of the field, when considered from the "static" point of view. Using wires of different diameter, but of the same total section, it is found that with increasing subdivision of the iron the difference between the static and dynamic curves dwindles, and so the general conclusion is drawn that the difference between the two curves is due to the eddy currents set up. The value of these currents is examined theoretically. The magnetisation curves of two wires of diameters in the ratio $1:a$ are identical when the frequencies acting on the two wires respectively are as $a^2:1$; and this relation is applied, by extrapolation, to higher frequencies (10^6). It is also found that with rapid cyclic processes (constant field amplitude) the energy dissipated per cycle decreases with increasing frequency in weak fields, and in strong fields at first increases and then decreases, thus clearing up the discrepancy between the observations of Wien and of Dina [see Abstracts Nos. 322 (1899) and 2050 (1900)]. Rutherford's method of determining damping is considered, in the light of the results obtained, as open to suspicion, and the disaccord between results by this method and those on Bjerknes' method, as shown by Rempp, are referred to. As applied to the Marconi detector the "dynamic" explanation of the effect is complicated by the presence of the slowly-varying field. It is pointed out that the effect should be greatest with increasing field [as was observed by Marconi]. A magnetometric investigation was also made in which the observation that an aperiodic discharge produces no alteration in a wire magnetised to saturation, when applied in a magnetising direction, suggested a method of determining one of the elements of an oscillatory circuit when two of these are known. No mention is made of recent work except that of Rempp. L. H. W.

2103. *Effect of Magnetisation on Elasticity.* **K. Honda** and **T. Terada.** (Mathematical and Physical Soc., Tokyo, 2. 25. pp. 381–390, Sept., 1905. Phys. Zeitschr. 6. pp. 622–628, Oct. 1, 1905.)—First the theoretical connection is shown between the factors (*a*) field to which a wire is subject, (*b*) the load on it, and (*c*) its elasticity. Data have already been obtained on certain relations, such as (1) change in length with change of field, and (2) change in elasticity with change in load, so that the effect looked for can be predicted and the curves drawn. On performing the experiments, very close agreement is found with the above values for various samples of iron and for cobalt.

P. E. S.

REFERENCES.

2104. *High-voltage Continuous or "Pertinacious" Currents.* **O. J. Lodge.** (Roy. Soc., Proc. 74. p. 319, Jan. 23, 1905.)—The author points out that the mercury-arc rectifier furnishes a convenient means of obtaining a very high voltage steady direct current from an alternating source or from a Ruhmkorff coil.

2105. *Stream-Line Method of Examining Magnetic Problems.* **A. Hay.** (Phys. Zeitschr. 6. pp. 290–293, May 1, 1905. Translation from the English.)—Describes the method which was dealt with in Abstract No. 101B (1905).

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

2106. *Diffusion of Nascent Hydrogen through Iron.* **A. Winkelmann.** (Ann. d. Physik, 17. 4. pp. 589–626, Aug. 22, 1905. From the Wüllner Festschrift, p. 36, 1905.)—The hydrogen is liberated electrolytically at the outer surface of an iron tube, whose interior is in communication with a vertical graduated glass tube, which serves to measure the gas and also as a manometer. The quantity of hydrogen diffusing into the inner tube in a given time and the pressure both inside and outside can be varied and determined. The temperature of the iron tube is in all cases observed. That the hydrogen when diffusing through the iron is in the atomic and not the molecular condition is clear from the fact that the rate of diffusion is independent of the gas pressure inside and outside of the tube for a range of variation of over an atmosphere; and further, the diffusion goes on even when the gas pressure is greater inside the tube than outside. Whatever the kind of pressure which causes diffusion, its value must be at least 58 atmos. The diffusion increases rapidly with increasing temperature, and if it varies as a power of the absolute temperature, this power must be at least 5. At constant temperature the rate of diffusion varies with the current which liberates the hydrogen, but does not increase as rapidly as the current; it is proportional to the actual p.d. which drives the current through the electrolyte. S. G. S.

2107. *Magnetic Rotation in Salt Solutions. Determination of the Absolute Magneto-optical Constant for Water.* **F. Agerer.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 803–830, June, 1905. From the phys. Inst. d. k.k. Univ., Innsbrück.)—The author finds that for aqueous solutions of sodium chloride, sodium iodide and potassium iodide, an increase of specific magnetic rotation accompanies a decrease of the strength of the solutions; cadmium iodide behaves in exactly the opposite way; potassium chloride and sodium sulphate show no change so far as could be ascertained with certainty. The absolute magneto-optical constant of water has the value 0·013098 at 18°; this agrees exactly with Rodger and Watson's determination. D. H. J.

2108. *Pyrometric Investigation of "Liquid" Crystals.* **T. Rotarski** and **S. F. Žemčužnyj.** (Ann. d. Physik, 17. 1. pp. 185–188, June 9, 1905.)—The temperature at which azoxyanisol becomes turbid or clear again is not constant and sharp, so that it does not appear on the solidification curve. When azoxyphenetol is rapidly cooled, the temperature at which it becomes turbid is marked in the curve by a hook which becomes smaller and smaller as the rate of cooling is diminished. With both these substances solidification is sharp. When emulsions separate, they give a characteristic zigzag curve very similar to those obtained for the above "liquid" crystals. With the separate components of an emulsion, no zigzag or hook formation is noticed in the curve. No case is as yet known where the latent heat of fusion is zero as is shown by the cooling-curve of azoxyanisol at 135°; it is hence evident that the temperature at which azoxyanisol becomes clear or turbid does not represent a melting-point. T. H. P.

2109. *Property of Certain Aluminium Alloys.* **H. Pécheux.** (Comptes Rendus, 140. pp. 1585–1586, June 5, 1905.)—A filed rod of the alloy $SnAl_3$ when immersed in water, yields 5–6 cub. cm. of hydrogen in 20 min.; a similar rod of Bi-Al yields a larger volume of gas, and one of Mg-Al still more. If one of these alloys is placed in a copper sulphate solution of density 1·1, the water is decomposed far more vigorously, and at the same time the copper sulphate is decomposed by the metal accompanying the aluminium. Zn-Al and Pb-Al alloys, which do not decompose water alone, cause evolution of hydrogen in copper sulphate solutions. The activity of these decompositions corresponds with the endothermic characters of the different solutions.

T. H. P.

2110. *Tantalum and Hydrogen.* **M. v. Pirani.** (Zeitschr. Elektrochem. 11. pp. 555–558, Aug. 25, 1905.)—Tantalum heated to a high temperature in hydrogen takes up 0·4 per cent. of its weight of the gas, or 740 times the volume of the tantalum as compared with 982 times the volume in the case of palladium. The product differs from the pure tantalum (1) in its appearance and mechanical characteristics—it becomes brittle, loses its tenacity, and acquires a crystalline structure; (2) in electrical properties. The electrical resistance increases until it reaches a maximum value from 1·7 to 2·1 times the original resistance. The temperature coefficient of the resistance also diminishes from the value for pure Ta, viz., 0·3 per cent. for 1° between 0 and 100, to 0·1 per cent. [See Abstract No. 1792 (1905).] On heating the tantalum-hydrogen product in a vacuum at a red heat, the hydrogen is easily driven off with the exception of 0·1 per cent. (about 190 volumes), which is with difficulty removed, and which probably exists chemically combined with the tantalum.

D. H. J.

2111. *Dielectric Constants of Phenols and their Ethers in Benzene and m-Xylene.* **J. C. Philip** and **Miss D. Haynes.** (Chem. Soc., Journ. 87. pp. 998–1003, July, 1905.)—From previous work by Philip [see Abstract No. 685 (1898)] and others, it appears probable that the variation of the dielectric property of an alcohol in benzene solution is connected with a variation of its molecular weight. It is sought to discover whether the dielectric power of phenol molecules in benzene solution (1) is markedly less than in the pure state, and (2) increases noticeably with the concentration. The results obtained for phenol itself and *m*- and *p*-cresol are, in general, parallel to those given by the alcohols, but the dielectric power of *o*-cresol is practically independent of the concentration. The increase in the value of $(\sqrt{k_2}-1)/d_2$ with concentration, detected for phenol in benzene solution, is observed also when *m*-xylene is used instead of benzene. The dielectric behaviour of anisole in benzene or *m*-xylene solution and of *o*-, *m*-, and *p*-tolyl methyl ethers in benzene solution, is normal; the dielectric constants of the ethers, as calculated by the formula—

$$[(\sqrt{k}-1)/d]\times 100=[(\sqrt{k_1}-1)/d_1](100-p_2)+[(\sqrt{k_2}-1)/d_2]p_2$$

(where k is the dielectric power of a mixture of two liquids, k_1 and k_2 those of the components, d, d_1, and d_2 the densities of the mixture, the first and the second component respectively, and p_2 the percentage by weight of the second component), are generally rather greater than the experimentally determined values, and the slight variation with the concentration is in the opposite direction to that of the parent phenol. The effect of ortho-substitution makes itself evident in the dielectric constants of the phenols themselves (and of anisole), the value for *o*-cresol (8 at 40°) being markedly less than the corresponding values for the meta- (18) and para- (18) derivatives. The dielectric constants of the phenols are much higher than those of the corresponding ethers. T. H. P.

2112. *Conductivity of Sulphuric Acid at Different Temperatures.* **B. C. Felipe.** (Phys. Zeitschr. 6. pp. 422–429, July 1, 1905. Translation from the Spanish.)—The view of Arrhenius that all compounds with a positive heat of ionisation possess a maximum conductivity at a certain temperature, which he verified by observations on phosphorous and hypophosphorous acids, seems to be of more general applicability. The solutions examined by the author contain from 2·66 to 35·34 mols. of water per mol. of sulphuric acid. The conductivity-temperature curve is convex towards the temperature axis for high concentrations of the acid, and concave for low concentrations. As the dilution increases, the temperature at the point of inflection becomes continually lower. The existence of the point of inflection is explained by the opposite influences of temperature in the mobility and degree of dissociation. If the conductivity is expressed as a function of the concentration at each temperature, the maxima of conductivity are more distinct for the higher temperatures. In the curve for the solution containing 14 mols. of water per mol. of sulphuric acid, there appear to be two maxima, but the existence of the intermediate minimum is not certain. T. H. P.

2113. *Influence of Solvent on Equilibrium Constants; Relation between Electrical Conductivity and Internal Friction.* **L. Pissarjewsky** and **N. Lemcke.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 37. Chem. part, pp. 492–502, 1905. Zeitschr. Phys. Chem. 52. pp. 479–493, July 21, 1905.)—The authors' results lead to the following conclusions: The equilibrium constant of the reaction, $2KCl + Hg_2SO_4 \rightleftarrows Hg_2Cl_2 + K_2SO_4$ is of different magnitude in different solvents. The temperature coefficient, between 25° and 44·2°, of the e.m.f. of the element—

$$\mathrm{Hg} \mid \frac{0{\cdot}01n\text{-KCl, } Hg_2Cl_2}{n\text{-KNO}_3} \mid n\text{-KNO}_3 \mid \frac{Hg_2SO_4\text{, } 0{\cdot}01n\text{-}K_2SO_4}{n\text{-KNO}_3} \mid \mathrm{Hg}$$

has almost the same value in water or 20 per cent. alcohol, but in 61·5 per cent. glycerine solution it is considerably greater. Addition of alcohol or glycerine to the solution causes an increase in the constant of the reaction. The electrical conductivity is exactly proportional to the degree of dissociation α, and inversely proportional to the internal friction η, so that $\mu = K\alpha/\eta$, the constant K having the value $\mu_\infty . \eta_\infty$. From this the value of α is obtained as $\mu\eta/\mu_\infty . \eta_\infty$, and not, as usually given, μ/μ_∞. The values of K for a solution of sodium chloride in water, 9·78 per cent. glycerine or 10·54 per cent. mannite are the same, the mean number being 132. The internal friction of a solution of sodium chloride in 9·78 per cent. glycerine from $v = 16$ to $v = 1,024$ increases and decreases periodically; a similar phenomenon is met with in a solution of the salt in 10·54 per cent. mannite solution. From $v = 64$ to $v = 512$, the internal friction of aqueous sodium chloride is less than that of water, the minimum lying at $v = 128$. This observation confirms the supposition of Arrhenius, that diminution of the internal friction of water by certain salts is explained by the considerable ionisation of these salts; it also renders more probable the conclusion that all salts with simple ions must diminish the internal friction of water at high dilutions. T. H. P.

2114. *Electrical Conductivity of Molten Potassium Nitrate, Sodium Nitrate, and of Mixtures of these.* **A. Bogorodsky.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 37. No. 6. pp. 760–807, 1905.)—The electrical conductivity was determined by the Kohlrausch method. For this purpose the nitrates were fused in two platinum basins which served as electrodes; the connection between the basins was made by means of a circularly bent glass capillary. By the regulation of a gas-burner playing on a sand bath in which the basins were placed, the temperature could be made to slowly rise or fall while measurements of the conductivity were being made at intervals. The following table gives in reciprocal ohms the specific conductivity of potassium nitrate, of sodium nitrate, and of mixtures of these, at different temperatures:—

Temp.	Percentage Weights of Potassium Nitrate.						
	100	94·392	73·224	54·323	49·386	14·493	0
348°	0·639	0·662	0·751	0·830	0·848	1·045	1·122
351°	0·649	0·671	0·760	0·843	0·857	1·048	1·137
354°	0·658	0·680	0·770	0·854	0·866	1·055	1·152
357°	0·667	0·689	0·779	0·865	0·877	1·067	1·166
360°	0·676	0·699	0·787	0·875	0·888	1·088	1·179
363°	0·685	0·709	0·796	0·885	0·901	...	1·192

The conductivities of the pure nitrates are thus found to be from 12 to 16 per cent. less than was determined by Bouty (1889), Braun, Foussereau, Graetz, and Poincaré. The conductivities of the mixtures of the nitrates are smaller than those calculated additively from the constituents.

The following table gives the specific conductivities in ohms^{-1} of some of the solutions of lead chloride, barium chloride, sodium sulphate, and lithium chloride in molten sodium nitrate; the original contains data also for other temperatures:—

Temp.	Lithium Chloride.		Barium Chloride.			
	0 % (100 % $NaNO_3$)	2·6 %	1·169 %	1·979 %	6·138 %	9·121 %
350°	1·133	1·141	1·124	1·107	1·073	1·024
355°	1·157	1·160	1·143	1·128	1·093	1·052
360°	1·179	1·180	1·163	...	...	...

Temp.	Lead Chloride.			Sodium Sulphate.		
	3·086 %	7·021 %	8·008 %	1·029 %	2·858 %	4·783 %
350°	1·113	1·083	1·079	1·122	1·087	1·048
355°	1·132	1·101	1·093	1·142	1·107	1·071
360°	1·152	1·118	1·106	1·162	1·129	1·094

Except in the case of lithium chloride the specific conductivity of sodium nitrate is lowered in each case by the added substance; this is attributed by the author to chemical combination with the solvent. D. H. J.

2115. *Hydration in Solution.* **G. N. Lewis.** (Zeitschr. Phys. Chem. 52. pp. 224–230, June 23, 1905. Translated from the English.)—It is proposed to use the well-known colour changes of salts, such as cobalt chloride and copper chloride and bromide as a test of the amount of hydrate-formation that takes place in solution, and a number of experiments of this kind are described. In presence of equivalent quantities of KBr, NaBr, LiBr, and NH_4Br, the colour of copper bromide is brownest in the case of LiBr and least brown in the case of KBr. This is attributed to the greater dehydrating action of the lithium salt, for if the change of colour were due to a change in the coefficient of ionisation of the copper salt, the brownest colouration should be produced by the highly dissociated potassium salt. The conclusions drawn from the colour-observations are in general agreement with those derived from freezing-point measurements, but it should be noted that Donnan and Bassett have been led to give quite a different explanation to the colour changes in the case of cobalt chloride solutions. T. M. L.

2116. *Colorimetric Method of Determining Dissociation Constants of Acids.* **F. H. Eydman, Jr.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 97–107, July 14, 1905. Proc. 8. pp. 166–175, Aug. 17, 1905.)—The author employed a colorimeter to determine the dissociation constants of acids by comparing the colour produced by the acid whose dissociation constant is to be determined with that produced by an acid whose dissociation constant is known. The reliability of the method was tested by determining the dissociation constant of benzoic acid, taking that of salicylic acid as known; metanilic acid was used as indicator. The result was then employed to determine the dissociation constant of anthranilic acid, which was employed for determining the constant of propionic acid, the indicator in the last two cases being methyl orange. The results obtained agree well with the constants calculated from conductivity measurements. F. J. B.

2117. *Refractory Materials for Furnace Linings.* **E. K. Scott.** (Faraday Soc., Trans. 1. pp. 289–296; Discussion, pp. 296–304, Aug., 1905.)—Refractory materials are classed under four groups, viz.: (i.) *Carbon*, for the highest temperature; (ii.) *Silicon carbides*, made in the electric furnace, such as (*a*) carborundum, (*b*) siloxicon, (*c*) amorphous or soft silicon carbide; (iii.) crystallised magnesia; and (iv.) ordinary fire-brick, magnesia brick, cement clinker brick, &c. The paper deals specially with the second and third groups and with the use of electric furnace products as furnace washes. Carborundum for ordinary furnace kilns should be mixed with silicate of soda; for dealing with basic slags, fireclay is used in place of silicate; for lining iron carborundum is mixed with silicate of soda. Siloxicon is partly self-binding, but the addition of finely-powdered alumina is recommended when the article to be protected can be baked thoroughly before use, and in other similar cases powdered refractory plastic non-alkaline clays can be used in addition. As a furnace lining either silicate of soda or coal tar may be employed. Silicon carbide, when used where mechanical strains are not anticipated, may be powdered and mixed in a solution of hot glue and water; in these cases a certain amount of free silicon is advantageous. Gas tar may be employed as a bond when neither conductivity nor oxidation are likely to give trouble. Where great mechanical strength is required this can be secured by causing the particles of silicon carbide to frit together by oxidation; this is effected by first using glue as a temporary binding agent and then heating to a high temperature for several hours in a strongly oxidising atmosphere. Crystallised magnesite electrically shrunk, *i.e.*, after the CO_2 is driven off, is advocated as a substitute for calcined magnesite bricks for basic furnaces; it has been used as a wash for the firebrick lining of a calcium carbide furnace. The substance used as a bond is not stated, but particulars are given of the electric power required to convert calcined magnesite into crystallised magnesia. *Discussion.*—**H. H. Dains** (*communicated*) considered the author's figures for the electric power required to be too high. **F. Gelstharp** (*communicated*) expressed disappointment at finding no material recommended for use in glass-making furnaces. He had tried magnesite bricks in a glass tank-furnace and found that they were seemingly unaffected for three or four weeks, failing very suddenly. This he attributed to the bricks retaining their shape, but increasing in size until they had absorbed the necessary amount of silica, soda, and lime to form a fusible silicate with the magnesia. **W. Murray Morrison** referred to the lack of exact data in the paper as to the temperature limits of the different materials mentioned. To the list of refractory materials he would like to add bauxite bricks and fused quartz, which had been used considerably in electric furnace work. **L. Gaster** pointed out that siloxicon, not being soluble in molten metals, could be used as a wash over bricks in contact with molten metals. **R. Cremer** stated that carborundum resisted mechanical strains better than any substance mentioned in the author's paper. He considered that, save when basic slag was present, silicate of soda was the best binding material. **R. S. Hutton** said that reference had not been made to "recrystallised carborundum." With regard to magnesite, he did not think the electric furnace was the place to get rid of the CO_2. **F. A. J. FitzGerald** (*communicated*) discussed the properties of carborundum and the silico-carbides. In reply, the **Author** pointed out that mechanical damage rather than heat necessitated the bulk of the renewals of furnace linings. W. P. D.

2118. *Microstructure of Silicon and Silicon Alloys.* **A. B. Albro.** (Amer. Electrochem. Soc., Trans. 7. pp. 251–270; Discussion, pp. 271–272, 1905.)—The author gives numerous photomicrographs of crystals and sections of silicon, ferro-silicons, copper silicons, and carbon-silicon compounds and mixtures. Sections of silicon on planes which were vertical during solidification show long grains as compared with the appearance in horizontal sections. The masses fracture readily along vertical, but not horizontal, planes. Under high magnification the surface of the octahedral silicon crystals shows overlapping striations similar to those noticed by Stead in 4 per cent. silicon steel. Heat treatments had no effect on the structure. The extremely brittle ferrosilicon of about 50 per cent. Si has a characteristic structure of octahedra. The higher Si alloys with iron contain this alloy and Si; those of less than 50 per cent. also contain it. Solid carbon and molten silicon do not necessarily react. "Carbosilicon" (Potter), which approximates to the formula Si_2C, is very hard and tough. It is very homogeneous in structure as compared with the other carbon-silicon mixtures. F. R.

2119. *Influence of Nitrogen on Iron and Steel.* **H. Braune.** (Soc. d'Encouragement, 107. Rev. de Métallurgie, pp. 497–502, July, 1905. Eng. Mag. 30. pp. 107–109, Oct., 1905. Abstract.)—The results of the author's researches are summarised. Pieces of different steels were heated in ammonia at 800° C., and afterwards annealed at lower temperature to distribute absorbed nitrogen. The tensile breaking strength of a very mild steel (0·06 per cent. carbon) increased uniformly with increasing nitrogen, whilst elongation decreased gradually to about 0·07 to 0·08 per cent. N, then very rapidly with higher content. The original metal showed uniformly etched grains, but with small percentages of N some of the grains etched rough, whilst others remained smooth. The roughness was in the form of parallel grooves, related to the polishing. The size of the grains diminished with increasing N, until with 0·07 to 0·08 per cent. their linear dimensions were about $\frac{1}{10}$ those of the original grains. The junctions of the grains also now became broader. At 0·2 per cent. N the original grains no longer appeared, but new short straight boundaries gave some resemblance to eutectic structure. Rapid diminution of elongation, accompanied by a change of structure, occurred at about 0·05 to 0·06 per cent. N in a 0·2 per cent., at 0·04 to 0·05 N in a 0·5 per cent., and at 0·08 to 0·085 per cent. N in a 1·15 per cent. carbon steel. It is rarely that as much as 0·06 to 0·07 per cent. N is found in commercial steels, yet the author attributes the occasional brittleness to nitrogen, and considers that it is because the critical content for high-carbon steels is so low that they are peculiarly liable to brittleness. The presence of nitrogen affects the results of quenching; it is suggested that a nitride of iron exists, in solution in iron in annealed pieces, and in solution in martensite in quenched pieces. Nitrogen affects also the electric and magnetic properties considerably; in particular, it increases coercive force and hysteresis in soft iron.—**H. le Chatelier.** (Ibid. pp. 503–507, July, 1905.) —le Chatelier discusses the bearing of Braune's results as offering possible explanations of inconsistencies in the behaviour of different steel samples of alleged identical composition, and of the brittleness in the interior of cemented pieces. Osmond observed Neumann's lines in brittle metals, and these lines can also be seen in Braune's iron specimen containing 0·2 per cent. N. Some photomicrographs of structures are given which have been observed in brittle mild steels, and which are similar to Braune's. A grooved appearance, as in one of Lecarme's specimens, which had become brittle by cementation, was also obtained [see Abstract No. 2121 (1905)]. It is suggested that these grooves are due to strain effects caused by and remaining after the polishing process; according to the orientation of the grain and its nitrogen content, it is more or less readily etched. The Neumann's lines are regarded as the traces of twinning planes. The brittleness in all specimens dealt with has been removable by heat treatment, but that this could be accomplished when N exceeds 0·1 per cent. is doubted; this would correspond to the effect of phosphorus. F. R.

2120. *Technique of Metallography.* **H. le Chatelier.** (Soc. d'Encouragement, 107. Rev. de Métallurgie, pp. 528–537, July, 1905.)—The author describes the further developments of his metallographic methods (Ibid. vol. 102, 1900). He uses a continuous process for elutriating emery flour. A slowly ascending stream of water meets the emery and carries the finer portions over to another vessel, where by gravity and centrifugal action they are thrown down. Alumina in suspension can be conveniently separated by drawing the liquid up into a pipette whose lower end is funnel-shaped; the powder is deposited at the bottom and can be allowed to fall out after the usual periods of time. The details of the boards and wheels used for polishing are given. The author has found that etching steel in boiling alkaline solutions containing any oxidising agents—particularly picric acid—readily colours cementite without attacking other constituents. 25 per cent. caustic soda and 2 per cent. picric acid answers well. He has now abandoned the mercury-arc lamp for photomicrography, and uses two large Nernst filaments, which give less perfect results, but with diminished exposure; and has practically abandoned the vertical camera, using one placed horizontally, with the interposition of a total-reflection prism. [See also Abstract of a paper on the same subject read before the Liége Congress, in Electrochem. Ind., N.Y. 3. pp. 366–367, Oct., 1905.] F. R.

2121. *Brittleness of Cemented Mild Steels.* **J. Lecarme.** (Soc. d'Encouragement, 107. Rev. de Métallurgie, pp. 516–525, July, 1905.)—The author's experiments lead him to conclude that the thermal treatment which is part of the carburising process does not make steel brittle. The superficial cementation is accompanied by an action in the interior of the mass, which becomes brittle upon quenching from 800° C. The carbon content in the interior does not increase, but the proportion of combined carbon at the centre of mild steel samples decreases during cementation. It is suggested that the carbon had combined with nitrogen, which is readily soluble in iron at red-heat. Although of very similar composition and properties, different makes of mild steels have their transformation points more or less displaced, in a range of 300°, by cementing, and can be classified accordingly. If the heat treatment and final quenching temperature be properly chosen, it is possible to avoid the brittleness to some extent, without sacrificing surface hardness. The internal parts then give a fibrous fracture, except when the sample is on the limit of a group found as above. One of two mild steels (analyses and strengths given) had to be cemented to a depth of 3 mm. to develop brittleness equal to that acquired by the other when cemented to 1 mm. only. The microstructures of several specimens are dealt with. In one case, an "anti-cement" (composition not stated—used for retaining toughness in any selected part of a cemented piece), having been employed, and the specimen quenched from 800° C., the structure was very large ferrite grains, troostitic boundaries and, presumably, sorbite.—**H. le Chatelier.** (Ibid. pp. 526–527, July, 1905.)—It is pointed out by le Chatelier that the tensile tests recorded do not show a difference between the interior of a cemented piece and a specimen submitted to the same heat treatment but not cemented. Bending tests, without removal of the cemented layer, do not settle the point. Lecarme's suggestion for avoiding brittleness is somewhat simpler than a method which the author has recommended—viz., to cool the cemented piece in air, heat above 900°, cool it again in air, heat to about 780°, then quench. The two former coolings need not be carried below 600°. F. R.

2122. *Microstructure and Friction of Bearing Metals.* **M. Price.** (Amer. Soc. Mech. Engin., Transactions, Vol. 26, 1905. Page's Weekly, 7. pp. 373–378, Aug. 18, 1905. Abstract.)—Friction was investigated by noting the retardation of a disc mounted on a shaft rotating freely in two well-lubricated half-bearings of the metal under test. Speed of rotation is plotted against time. Of pure metals, Cu brought the spindle to rest most rapidly, followed by Pb and Al. The curves differ in detail—that of Cu being almost uniform; the resistance offered by Pb was very slight at a journal speed of about 40 ft. per min. In series of alloys having one predominant metal some similarities of detail of the curves appear. Nothing in the nature of a general law of variation of friction with velocity could be determined. On the whole the differences were not satisfactorily explained by means of abrasion. On the other hand, the "lower orders of asperity"—mechanical imperfections and microstructural features—cause a roughly constant increase of frictional resistance. This is opposed to Charpy's conclusion that it is the hard grains which contribute the antifriction property of the alloy. Some of the figures agree, and some do not, with Goodman's conclusion that if the third component were a metal of high atomic volume, the resistance was diminished, but if of low atomic volume, increased. F. R.

2123. *Crystallisation of Wrought Iron.* **J. O. Arnold.** (Engineer, 100. p. 158, Aug. 18, 1905.)—The author shows a photomicrograph of the fracture of a bolt which broke very easily during removal from the position in which it had been used for many years. The central part exhibits perfect cubic cleavage. As the analysis showed C 0·047, Si 0·157, and P 0·35 per cent., the author considers the abnormal crystallisation to be due to phosphorus, aided by the vibration during use. Under test in the author's machine [see Abstracts Nos. 1929B, 2795B (1904)], a piece of this bolt broke with 12 alternations, whilst a comparison specimen of good wrought iron broke with 228 alternations. The latter bent double cold by hammering and closing in vice, without flaw; the former also closed, but tore badly. F. R.

2124. *Copper-Aluminium Alloys.* **L. Guillet.** (Comptes Rendus, 141. pp. 464–467, Sept. 4, 1905. Soc. d'Encouragement, 107. Rev. de Métallurgie, pp. 567–588, Aug.–Sept.–Oct., 1905.)—The author observed seven constituents in copper-aluminium alloys:—α, solid solution of 0 to 8 per cent. Al in Cu, hitherto confused with Cu_3Al; β, either Cu_3Al or a solid solution; γ, solid solution found on quenching alloys of 8·6 to 11·8 per cent. Al from above the critical point (about 490° C.); δ, solid solution occurring in alloys of 14 to 30 per cent. Al; ϵ, solid solution in 30 to 46 per cent. Al alloys; η, Al_2Cu, in 44 to 66 per cent. alloys; with 66 per cent. Al, the whole mass consists of eutectic of η and H; H, either pure Al or solid solution containing very little Cu. The temperature range of solidification of the following alloys was zero:—0 to 8, about 11 or 12, 30, 46 to 48, and 66 per cent. Al. Alloys up to 8 per cent. Al had no critical point; those with higher content showed a critical point at a temperature falling from 490° to 390° with increasing Al, and another at about 150°. F. R.

2125. *Bismuth-Tellurium Alloys.* **K. Mönkemeyer.** (Zeitschr. Anorg. Chem. 46. 4. pp. 415–422, Sept. 18, 1905. Inst. f. anorg. Chemie d. Univ., Göttingen.)—Describes pyrometric and microscopic investigations of this series of alloys; the results are summarised in a temperature-concentration diagram which shows two eutectic points and one well-defined maximum at a composition of 40 atomic per cent. Bi, proving the existence of a compound of the composition Bi_2Te_3, which the authors find to be the only definite compound formed. The melting-point of this compound, 560° C., is considerably higher than that of either element. W. Ros.

2126. *Iron-Manganese Alloys.* **M. Levin** and **G. Tammann.** (Zeitschr. Anorg. Chem. 47. 1. pp. 136–144, Oct. 3, 1905. Metallographic Communication from the Inst. f. anorg. Chemie d. Univ., Göttingen.)—Describes a series of determinations of the melting-points of manganese and its alloys with iron; the manganese employed was obtained by the Thermit process, while the iron was furnished by Krupp and contained only 0·07 per cent. carbon, and was in other respects very pure. 20 gm. of alloy were fused in a porcelain crucible in an electric carbon-tube furnace and temperatures measured by a thermo-couple specially protected by means of a layer of magnesia. The melting-point of pure Mn as found by the authors (1,247° C.) differs only very slightly from the value (1,245° C.) found by Heraeus [see

Abstract No. 2221 (1902)]. In the alloys the beginning and end of crystallisation was alone observed, the curve plotted giving the melting-points and duration of crystallisation only. This curve is a smooth one, and the authors conclude that Fe and Mn form an unbroken series of mixed crystals. The microstructure of the ingots when cooled in the ordinary way does not appear to bear out this conclusion, since two sharply-defined constituents appear in the sections, but the authors attribute this to the rapid rate of cooling, which did not allow of the establishment of full equilibrium between the crystals and their mother-liquor during solidification ; an ingot that was cooled much more slowly showed a much closer approach to homogeneous structure. The effects of Mn on the transformation temperatures of Fe were not investigated, and the magnetic properties of the Mn steels produced only slightly examined by means of an indicating magnetic needle. The results diverge somewhat from those of Hadfield, but the authors ascribe this to differences in the rate of cooling. W. Ros.

2127. *Nitrogen Oxides from Compressed Air by the Electrical Method.* **E. Rossi.** (Gazzetta Chim. Ital. 35. 1. pp. 89–110, April, 1905.)—The author has examined the amount of nitric oxide formed when air is passed over a glowing Nernst filament in varying quantities and at varying rates and pressures, the nitric oxide produced being determined by a Lunge nitrometer. Increase of current rapidly increases the yield (with currents of 0·22, 0·25, 0·28 amp., yields of 0, 3·3, and 6·5 cub. cm. respectively). One litre of air at rest was found to give as much nitric oxide (when removed as formed) as was obtained from 5 litres of air passed slowly, or 10 litres at twice the speed. The efficiency is small with still air, 100 cub. cm. being obtained in 3¼ hours with one lamp from 5·2 litres of air at 100 atmos. pressure with a current of 1 amp. By absorbing the oxides as formed, with conc. sulphuric acid, the yield was increased to 35 per cent. in 2 hours from 1¼ litres of air at 50 atmos. pressure. The reaction velocity decreases with time, owing to exhaustion of oxygen. At 90 atmos. pressure the reaction is at first more rapid, but then slower, than at 50 atmos. L. H. W.

2128. *Preparation of Oxides of Nitrogen by High-tension Discharges.* **O. Scheuer.** (Zeitschr. Elektrochem. 11. pp. 565–580, Sept. 1, 1905. Communication from the Chem.-techn. u. elektrochem. Inst. d. techn. Hochschule, Darmstadt.)—The author's experiments on high-tension discharges in air, carried out partly with a Ruhmkorff coil and partly with a high-tension alternating-current transformer, show that the gaseous products are NO, NO_2, N_2O_4, N_2O and ozone. When the spark inductor is used, the yield of nitrogen oxides, for a given quantity of air and constant consumption of energy per unit of time, increases with the velocity of the air. Increase of the energy consumption for a given volume of air causes a diminution in the yield. In comparison with the theoretical yields, those obtained are small, and no change in the shape of the vessel improves them appreciably. When the alternating-current transformer is used, only the current consumption in the primary circuit can be given, the considerable loss of energy in the secondary circuit making the percentage yields appear small. Of great importance are the forms of the electrodes and flames ; the surface of the latter must be as large as possible, the air being thus carried through with a favourable velocity, and the gases after reaction prevented from again entering the flame. Moisture increases the yield, ammonia being formed at the same time. T. H. P.

2129. *Production of Ozone by Ultra-violet Light.* **F. Fischer** and **F. Braehmer.** (Phys. Zeitschr. 6. pp. 576–579, Sept. 15, 1905. From I. Chem. Inst. d. Univ., Berlin. Chem. News, 92. pp. 141–143, Sept. 22, 1905. Ber. Deut. Chem. Gesell. 38. pp. 2633–2639, July 22, 1905.)—The source of ultra-violet light is a mercury arc lamp, and inside this is set a quartz tube through which pure oxygen is caused to pass. The quartz being transparent to ultra-violet light, ozone is produced, and the rate of production is under control and can be measured. The chief difficulty is the disturbance caused by the heat of the mercury arc, and to reduce this effect a stream of cold water passes through a glass tube inside the quartz one. By measuring the rate of production of ozone, the current in the arc, the oxygen current through the quartz tube and the temperature of the entering and leaving water, it is found that (i.) the more effectual the cooling, the greater is the percentage of ozone produced; (ii.) increasing the arc current from 2 to 8 amps. caused (in one case) an increase from 0·183 to 0·219 in the percentage of ozone present; (iii.) increasing the oxygen current causes a decrease in the percentage of ozone; and (iv.) the effects of impurities such as water vapour, &c., are not definite enough to lead to any conclusion. At a temperature of 270° ozone ceases to be formed, or, what is more probable, the rate at which ozone is produced from oxygen is equal to that of the reverse process. S. G. S.

2130. *Electroplating Aluminium.* **A. Lodyguine.** (Amer. Electrochem. Soc., Trans. 7. pp. 153–156, 1905.)—The experiments of the author have been directed to cover thin plates of aluminium with layers of antimonious lead or with antimony. It was found that the formation of any compound of aluminium on the surface of the plate must be avoided. The presence of the slightest traces of alumina, chloride or sulphate of aluminium, aluminates or alums, absolutely ruined the success of the experiment. Any electrolyte that attacks the aluminium must therefore be discarded. No good solution from which lead or antimonious lead could be plated on aluminium was found, but he succeeded in depositing copper by the following process: An anode of pure copper and an electrolyte of water with a few drops of sulphuric acid was used. After the current had been passed for some time, some $CuSO_4$ was formed, and from this copper was deposited. The plate was taken out after 30 min. and well washed in water, then in a solution of HCl, next in NaOH solution, and finally in water. The same operation was repeated several times, until the plate was evenly coated with copper. On the coppered plate antimony was deposited from a concentrated solution of Na_2S. Lumps of trisulphide of antimony were placed in a porous pot with a carbon anode. The cell was filled with the electrolyte. On the coppered aluminium kathodes the antimony adheres firmly, and the deposit can be continued as long as the monosulphide of sodium is not converted into polysulphides. A current density of 0·0013 amp. per sq. in. with 1 to 1·5 volts was found to be satisfactory. W. W. H. G.

2131. *Electrolytic Analysis of Antimony.* **H. D. Law** and **F. M. Perkin.** (Faraday Soc., Trans. 1. pp. 262–263; Discussion, p. 263, Aug., 1905.)—Very satisfactory results have been obtained by electrolysing hot solutions of an antimony salt, containing, in place of sodium sulphide, from 6 to 8 gm. of ammonium tartrate to each 120 cub. cm. of solution, the whole of the antimony being deposited in from 3 to 5 hours, employing a current density of 0·2 — 1·0 amps., and an e.m.f. of 2·6 — 3·5 volts. With hot solutions the deposit adheres well to the kathode, but cold solutions cannot be depended upon, the deposit tending to be brittle and to exfoliate. The metal deposited from hot solutions is frequently slightly brown in colour, but its appearance is improved by the addition of 1 gm. of tartaric acid to the electrolyte. W. H. St.

2132. *Reduction of Oleic Acid to Stearic Acid by Electrolysis.* **J. Petersen.** (Zeitschr. Elektrochem. 11. pp. 549–553, Aug. 25, 1905. From Öfversigt over det Kgl. danske Videnskabernes Selskabs Förhandlinger, No. 2, 1905.) —Oleic acid in solution in alcohol which has been acidified by hydrochloric or sulphuric acid may be reduced by the action of a current of less than 2 amps. and of a few volts to stearic acid. The best results are obtained when only very little acid is present. D. H. J.

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2133. *Atomic Weight of Nitrogen from the Ratio of the Densities of Nitrogen and Oxygen.* **P. A. Guye.** (Comptes Rendus, 140. pp. 1386–1389, May 22, 1905.)—The author shows that the densities of gases, determined at corresponding temperatures and pressures and reduced to 0° and 1 atmosphere pressure by the formula for perfect gases, are strictly proportional to the molecular weights of the gases. This theorem is verified for oxygen and nitrogen in the conditions of greatest accuracy. The mean of the values of the atomic weight of nitrogen obtained by all the various density methods is 14·009. T. H. P.

2134. *Dynamic Isomerism of Derivatives of Glucose. Mutarotation of the Sugars.* **C. L. Jungius.** (Zeitschr. Phys. Chem. 52. pp. 97–108, June 9, 1905. Chem. Laborat. d. Univ., Amsterdam.)—The isomeric α- and β-methyl glucosides undergo reversible isomeric change when dissolved in methyl alcohol containing hydrogen chloride; equilibrium is attained when the proportions are $\alpha:\beta=77:23$. In the case of the isomeric galactosides, $\alpha:\beta=62:38$; for the isomeric pentacetates of glucose, $\alpha:\beta=90:10$. The paper discusses the phenomena underlying mutarotation and reviews the theories advanced to account for these changes. T. M. L.

2135. *Chemical Glassware.* **P. H. Walker.** (Amer. Chem. Soc., Journ. 27. pp. 865–875, July, 1905. Contribution from the Bureau of Chemistry, Dept. of Agriculture, No. 58.)—The author gives the results of mechanical and solubility tests on chemical glassware made from a number of different kinds of glass. Wiener Normal glass is found to be the least resistant to reagents, but the other trade-mark glasses exhibit very little difference in quality. T. H. P.

2136. *Shrinkage of Oxides during Ignition* ["*Feuerschwindung.*"] **R. Lucas.** (Zeitschr. Phys. Chem. 52. pp. 327–342, July 7, 1905. Abstract of Dissertation, Göttingen, 1903.)—Experiments were made to determine the shrinkage which took place in rods of cobalt oxide, magnesia, kaolin and zirconium oxide when heated at temperatures ranging from 100–2,000° C. The shrinkage depends on the rate of heating, and is greater if the body is heated quickly than slowly, but this difference disappears at high temperatures. The actual density of the material is not substantially altered, and practically the whole of the contraction is due to the decrease of porosity. T. M. L.

2137. *Equilibrium in the Systems:* $TlNO_3$*–*KNO_3*,* $TlNO_3$*–*$AgNO_3$*, and* $TlNO_3$*–*$NaNO_3$*.* **C. van Eyk.** (Zeitschr. Phys. Chem. 51. pp. 721–731, May 9, 1905. Chem. News, 91. pp. 295–298, June 30, 1905.)—The author gives a complete account of the solidification and transformation phenomena in these systems. [Compare Abstract No. 680 (1900).] T. H. P